Vol. I

TRANSCRIPT OF RECORD

Supreme Court of the United States

OCTOBER TERM, 1939

No. 9

STANDARD BRANDS, INCORPORATED,
PETITIONER,

vs.

NATIONAL GRAIN YEAST CORPORATION

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APEALS FOR THE THIRD CIRCUIT

PETITION FOR CERTIORARI FILED FEBRUARY 25, 1939.

CERTIORARI GRANTED MARCH 27, 1939.

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IN THE

District Court of the United States,

FOR THE DISTRICT OF NEW JERSEY.

E-4552. IN EQUITY.

LETTERS PATENT NOS. 1,449,103; 1,449,105; 1,449,106; 1,449,109; 1,449,127; 1,449,134; 1,475,215; 1,673,735 and 1,688,831.

STANDARD BRANDS, INCORPORATED,

v.

NATIONAL GRAIN YEAST CORPORATION.

DOCKET ENTRIES.

Dec. 30, 1932.	Bill of Complaint filed.
Jan. 3, 1933.	Subpœna issued.
Jan. 6, 1933.	Plaintiffs Interrogatories and Allowance filed.
Jan. 11, 1933.	Subpœna returned, served on January 4th, filed.
Jan. 25, 1933.	Order extending time to Answer, filed.
Feb. 17, 1933.	Stipulation and Order extending time to Answer, filed.
Mar. 10, 1933.	Notice of Motion for extension of time to plead, filed.
Mar. 10, 1933.	Order extending time to Answer filed.
Apr. 10, 1933.	Notice and Motion to Dismiss Bill, for Bill of Particulars and to extend time, filed.

Apr. 19, 1933.	Order denying motion and extending time to Answer, filed.
Apr. 24, 1933.	Plaintiffs Amended Interrogatories filed.
May 1, 1933.	Answer filed.
May 8, 1933.	Answers to Plaintiffs Amended Interrogatories, filed.
May 23, 1933.	Stipulation and Order re Interrogatories, filed.
May 29, 1933.	Stipulation adjourning hearing filed.
June 7, 1933.	Defendant's Additional Answers to plaintiff's Amended Interrogatories, filed.
June 19, 1933.	Order appointing James D. Carpenter, Special Master, as to Interrogatories, filed.
July 6, 1933.	Special Master's Report filed.
July 25, 1933.	Order amending defendants Objections to Plaintiffs Amended Interrogatories, filed.
Aug. 1, 1933.	Defendant's Answers to Plaintiffs Amended Interrogatories, &c., filed.
Jan. 23, 1934.	Appearance filed.
Apr. 3, 1934.	Stipulation re trial of case filed.
May 8, 1934.	Amendment to Answer filed.
June 11, 1934.	Stipulation and Order re hearing of case filed.
Jan. 15, 1935.	Notice of Motion to assign date of Trial filed.
Mar. 1, 1935.	Notice of Motion for Commission to take Testimony abroad filed.

Mar. 4, 1935.	Hearing on Motion for commission to take Testimony abroad. Motion granted. (Clark).
Mar. 18, 1935.	Order for Issuance of Commission filed.
Mar. 25, 1935.	Bond of Defendant, filed.
Apr. 12, 1935.	Commission issued.
Apr. 23, 1935.	Order for Issuance of Letters Rogatory in lieu of Commissions filed.
June 10, 1935.	Notice of Motion and Motion for setting of case for Trial filed.
July 8, 1935.	Order for Defendant to file Undertaking filed.
July 19, 1935.	Order vacating Order for Undertaking and for Defendant to file further Undertaking, &c., filed.
July 23, 1935.	Stipulation re bond of $15,000 filed.
July 23, 1935.	Order for filing of bond nunc pro tunc filed.
July 23, 1935.	Bond of $15,000 filed.
Aug. 20, 1935.	Amendment to Answer filed.
Aug. 20, 1935.	Bond of $15,000 filed.
July 18, 1935.	Depositions of Dr. Friedrich Hayduck and Dr. Frederick Wendel, filed.
Sept. 20, 1935.	Bond by defendant filed.
Oct. 11, 1935.	Stipulation and Order to withdraw exhibits and Depositions filed.
Oct. 15, 1935.	Final Hearing adjourned to October 16.
Oct. 16, 1935.	Final Hearing adjourned to October 18.

Oct. 18, 1935.	Final Hearing adjourned to October 22.
Oct. 22, 1935.	Final Hearing adjourned to October. 23.
Oct. 23, 1935.	Final Hearing adjourned to October 24.
Oct. 24, 1935.	Final Hearing adjourned to October 25.
Oct. 25, 1935.	Final Hearing adjourned to October 29.
Oct. 29, 1935.	Final Hearing adjourned to October 31.
Oct. 31, 1935.	Final Hearing continued. Adjourned to Nov. 1.
Nov. 1, 1935.	Final Hearing continued. Adjourned to Nov. 8.
Dec. 3, 1935.	Final Hearing continued. Final argument adjourned to date to be fixed. (Fake).
Mar. 2, 1936.	Defendants Motion for Order Amending Answer and Reopening Proofs filed.
Mar. 2, 1936.	Order granting Motion for Order Amending Answer and Reopening Proofs, filed.
May 5, 1936.	Final Argument. Decision Reserved. (J. Fake).
Apr. 9, 1937.	Substitution of Attorney filed.
Oct. 29, 1937.	Memorandum filed (Fake).
Nov. 23, 1937.	Hearing on Motion by Defendant to reduce amount of bonds. Argument in Chambers. Motion denied. (Fake).

Nov. 30, 1937.	Findings of Fact and Conclusions.
Nov. 30, 1937.	Final Decree Dismissing Bill as to Hayduck Patents and Corby Patent and for Injunction for Accounting, &c., filed.
Nov. 30, 1937.	Assignment of Errors filed.
Nov. 30, 1937.	Petition on Appeal filed (Allowance).
Nov. 30, 1937.	Stipulation re taxation of costs, filed.
Nov. 30, 1937.	Citation issued.
Dec. 3, 1937.	Citation returned, Service acknowledged Dec. 1, Copy filed.
Dec. 6, 1937.	Bond on Appeal filed.
Dec. 20, 1937.	Assignment of Errors and Petition for Appeal and Allowance filed (From Interlocutory Decree).
Dec. 20, 1937.	Citation issued.
Dec. 20, 1937.	Order staying accounting until Decision of U. S. Circuit Court filed.
Dec. 22, 1937.	Stipulation re objection to evidence filed.
Dec. 23, 1937.	Stipulation and Order extending time on Appeal. Copy filed.
Dec. 28, 1937.	Citation returned, service acknowledged Dec. 20. Copy filed.
Dec. 29, 1937.	Bond on Appeal filed.
Jan. 19, 1938.	Stipulation and Order extending return days of Citation. Copy filed.
Feb. 16, 1938.	Stipulation and Order extending return days of Citation. Copy filed.
Mar. 22, 1938.	Stipulation and Order extending return days of Citation. Copy filed.
Mar. 29, 1938.	Narrative Form of Transcript of Record, filed.

BILL OF COMPLAINT.

(Filed December 30, 1932.)

IN THE DISTRICT COURT OF THE UNITED STATES,
FOR THE DISTRICT OF NEW JERSEY.

No. . IN EQUITY.

ON UNITED STATES LETTERS PATENT NOS. 1,449,103, 1,449,105, 1,449,106, 1,449,109, 1,449,127, 1,449,134, 1,475,215, 1,673,735 AND 1,688,831.

Standard Brands Incorporated,
Plaintiff,

v.

National Grain Yeast Corporation,
Defendant.

To the Honorable, the Judges of the United States District Court for the District of New Jersey:

Standard Brands Incorporated, the above-named plaintiff, brings this bill of complaint against National Grain Yeast Corporation, the above-named defendant, and alleges:

1. Plaintiff is a corporation duly organized and existing under and by virtue of the laws of the State of Delaware, having an office and place of business in New York, N. Y.

2. Defendant, as plaintiff, is informed and believes and therefore avers, is a corporation organized and existing under the laws of the State of New Jersey, and has an office and place of business in Belleville, County of Essex, State of New Jersey, where and elsewhere

defendant has committed the acts of infringement herein alleged.

3. This is a suit for infringement of United States Letters Patent, and the jurisdiction of this Court is invoked under the patent laws of the United States.

4. Heretofore Friedrich Hayduck of Wilmersdorf, Germany, a citizen of Germany, being within the meaning of the statutes of the United States the first, original and sole inventor of certain new and useful improvements in Process for the Manufacture of Compressed Yeast and the Product, duly set forth, described and claimed in United States Letters Patent No. 1,449,103, patented March 20, 1923, under the Act of March 3, 1921, and certain new and useful improvements in Low-Alcohol Yeast Process, duly set forth, described and claimed in United States Letters Patent No. 1,449,105, 1,449,106 and 1,449,109, all patented March 20, 1923, under the Act of March 3, 1921 and not known or used by others in this country, before his invention or discovery thereof, and not patented or described in any printed publication in this or any foreign country, before his invention or discovery thereof, or more than two years prior to his respective applications therefor, and not in public use or on sale in this country for more than two years prior to his respective applications for said letters patent, and which had not been abandoned, did on or about October 30, 1920, make application in due form of law for Letters Patent of the United States for said inventions.

5. Thereafter, and prior to the issuance of said letters patent, said Friedrich Hayduck, by instruments in writing duly signed, sealed and delivered, and recorded in the United States Patent Office, duly assigned to The Fleischmann Company, a corporation of Ohio, the entire right, title and interest in and to said appli-

cations and the inventions therein described and claimed, and the patents to be issued thereon, and all the requirements of the statutes, and rules of practice in the Patent Office, then in force, having been duly complied with, Letters Patent of the United States Nos. 1,449,103, 1,449,105, 1,449,106 and 1,449,109 were duly, pursuant to said applications and assignments issued on March 20, 1923, to said The Fleischmann Company, as assignee of said Friedrich Hayduck.

6. Heretofore Martin Nilsson and Norman S. Harrison, both of Peekskill, N. Y., and citizens of the United States, being within the meaning of the statutes of the United States the first, original and joint inventors of certain new and useful improvements in Process for Producing Yeast, duly set forth, described and claimed in United States Letters Patent No. 1,449,127, patented March 20, 1923, not known or used by others in this country before their invention or discovery thereof and not patented or described in any printed publication in this or any foreign country before their invention or discovery thereof, or more than two years prior to their application therefor, and not in public use or on sale in this country for more than two years prior to said application, and which had not been abandoned, did, on the seventh day of January, 1919, make application in due form of law for Letters Patent of the United States for said invention.

7. Thereafter, and prior to the issuance of said letters patent, said Martin Nilsson and Norman S. Harrison, by instrument in writing duly signed, sealed and delivered, and recorded in the United States Patent Office, duly assigned to The Fleischmann Company, a corporation of Ohio, the entire right, title and interest in and to the said application and the inventions therein described and claimed, and the patent to be issued thereon, and all the requirements of the statutes and

rules of practice in the Patent Office, then in force, having been complied with, Letters Patent of the United States No. 1,449,127 were duly, pursuant to said application and assignment, issued on March 20, 1923, to said The Fleischmann Company as assignee of said Martin Nilsson and Norman S. Harrison.

8. Heretofore Alfred Wohl of Danzig-Langfuhr, Free City of Danzig, being within the meaning of the statutes of the United States the first, original and sole inventor of certain new and useful improvements in a Method of Treating Molasses, duly set forth, described and claimed in United States Letters Patent No. 1,449,134, patented March 20, 1923, and also in a Process for the Manufacture of Yeast, duly set forth, described and claimed in United States Letters Patent No. 1,475,215, patented November 27, 1923, under the Act of March 3, 1921, the application for which was a continuation in part of application for United States Letters Patent filed June 23, 1920, Serial No. 391,156, and a continuation of application for United States Letters Patent filed August 31, 1921, Serial No. 497,322, which said inventions were not known or used by others in this country, before his invention or discovery thereof, and not patented or described in any printed publication in this or any foreign country, before his invention or discovery thereof, or more than two years prior to his said first respective application therefor, and not in public use or on sale in this country for more than two years prior to his said application, and which had not been abandoned, did, on or about August 31, 1921, make applications in due form of law for Letters Patent of the United States for said inventions.

9. Thereafter, and prior to the issuance of said letters patent, said Alfred Wohl, by instruments in writing duly signed, sealed and delivered, and recorded

in the United States Patent Office, duly assigned to The Fleischmann Company, a corporation of Ohio, the entire right, title and interest in and to the said applications and the inventions therein described and claimed and the patents to be issued thereon, and all the requirements of the statutes and rules of practice in the Patent Office, then in force, having been complied with, Letters Patent of the United States Nos. 1,449,134 and 1,475,215 were duly, pursuant to said applications and assignments, issued on March 20, 1923, and November 27, 1923, respectively, to said The Fleischmann Company as assignee of said Alfred Wohl, as by said instruments of assignment or duly authenticated copies thereof ready in court to be produced, and, as by the original or duly certified copies of said letters patent ready in court to be produced, will more fully appear.

10. Heretofore Robert L. Corby of New York, N. Y., a citizen of the United States, and Wilhelm H. F. Bührig, of Mount Vernon, N. Y., a citizen of Germany, being within the meaning of the statutes of the United States the first, original and joint inventors of certain new and useful improvements in Process for the Manufacture of Yeast, duly set forth, described and claimed in United States Letters Patent No. 1,673,735, patented June 12, 1928, not known or used by others in this country before their invention or discovery thereof, and not patented or described in any printed publication in this or any foreign country before their invention or discovery thereof, or more than two years prior to their application therefor, and not in public use or on sale in this country for more than two years prior to said application, and which had not been abandoned, did, on the sixteenth day of August, 1924, make application in due form of law for Letters Patent of the United States for said invention.

11. Thereafter, and prior to the issuance of said letters patent, said Robert L. Corby and Wilhelm H. F. Bührig, by instrument in writing duly signed, sealed and delivered, and recorded in the United States Patent Office, duly assigned to The Fleischmann Company, a corporation of Ohio, the entire right, title and interest in and to the said application and the inventions therein described and claimed, and the patent to be issued thereon, and all the requirements of the statutes and rules of practice in the Patent Office, then in force, having been complied with, Letters Patent of the United States No. 1,673,735 were duly, pursuant to said application and assignment, issued on June 12, 1928, to said The Fleischmann Company as assignee of said Robert L. Corby and Wilhelm H. F. Bührig.

12. Heretofore Fred Ransohoff of New York, N. Y., a citizen of the United States, being within the meaning of the statutes of the United States the first, original and sole inventor of certain new and useful improvements in a Method of Treating Molasses, duly set forth, described and claimed in United States Letters Patent No. 1,688,831, patented October 23, 1928, not known or used by others in this country before his invention or discovery thereof, and not patented or described in any printed publication in this or any foreign country before his invention or discovery thereof, or more than two years prior to his application therefor, and not in public use or on sale in this country for more than two years prior to said application, and which had not been abandoned, did, on the eleventh day of May, 1925, make application in due form of law for Letters Patent of the United States for said invention.

13. Thereafter, and prior to the issuance of said letters patent, said Fred Ransohoff, by instrument in writing duly signed, sealed and delivered, and recorded

in the United States Patent Office, duly assigned to The Fleischmann Company, a corporation of Ohio, the entire right, title and interest in and to the said application and the invention therein described and claimed, and the patent to be issued thereon, and all the requirements of the statutes and rules of practice in the Patent Office, then in force, having been complied with, Letters Patent of the United States No. 1,688,831 were duly, pursuant to said application and assignment, issued on October 23, 1928, to said The Fleischmann Company as assignee of said Fred Ransohoff.

14. Thereafter, and on or about the sixteenth day of September, 1929, said The Fleischmann Company being the owner of all right, title and interest in and to said Letters Patent Nos. 1,449,103, 1,449,105, 1,449,106, 1,449,109, 1,449,127, 1,449,134, 1,475,215, 1,673,735 and 1,688,831 duly and by written instrument, assigned said letters patent and all right of suit and recovery for the infringement thereof to the plaintiff Standards Brands Incorporated, which has ever since remained and now is sole and exclusive owner thereof, all as will more fully appear from the original or duly certified copies of said letters patent and assignments ready in court to be produced and of which the plaintiff makes due profert.

15. By letters patent above enumerated, there was secured to plaintiff and its said predecessor the exclusive right throughout the United States and its territories for the duration of each of said patents respectively, to make, use and sell the inventions therein described and claimed; that plaintiff and its said predecessor have been and that plaintiff now is using them in the conduct of the business of manufacturing and selling yeast; that plaintiff and its predecessor expended large sums of money in acquiring and developing said inventions and in connection with said letters

patent and the applications therefor; and the use of said inventions has been profitable to plaintiff and its predecessor and of great benefit to the public.

16. Plaintiff further avers that the said letters patent and the exclusive rights of plaintiff and its said predecessors in the same have been generally recognized and respected by the public since the issuance of said letters patent; that in one instance where certain of said letters patent were infringed by Federal Yeast Corporation, said infringement was terminated by a permanent injunction issued by the United States District Court for the District of Maryland, pursuant to an opinion of said Court reported in 8 F. (2d) 186, and affirmed by the United States Circuit Court of Appeals for the Fourth Circuit in 13 F. (2d) 570, and by an injunction issued by the District Court for the District of Maryland, pursuant to an opinion reported in 38 F. (2d) 329; that, pursuant to the said opinions, the United States District Court for the District of Maryland adjudicated the Hayduck patent in suit No. 1,449,103 valid and infringed as to claims 1, 2, 3, 4, 7, 8, 11, 12, 13, 14 and 15; the Hayduck patent in suit No. 1,449,105 valid and infringed as to claims 4, 8, 9 and 10; the Hayduck patent in suit No. 1,449,106 valid and infringed as to claims 1, 3, 4, 5, 6, 8, 12 and 13; and that the Nilsson and Harrison patent in suit No. 1,449,127 was, in the first of said cases, held invalid by reason of the interpretation placed by the said courts upon the Act of Congress of March 3, 1921, Revised Statute § 4887, but said interpretation is believed by the plaintiff to be erroneous and said Patent No. 1,449,127 likewise valid.

17. Plaintiff is informed and believes and therefore avers that since the grant of said letters patent and within six years last past, and since the plaintiff

acquired the same, and prior to the filing of this bill, at Belleville within the District of New Jersey, and elsewhere within the United States, the defendant has been and now is infringing said Letters Patent Nos. 1,449,103, 1,449,105, 1,449,106, 1,449,109, 1,449,127, 1,449,134, 1,475,215, 1,673,735 and 1,688,831, and each of them, with full knowledge of the plaintiff's rights in the premises, and without license of the plaintiff but in violation of the plaintiff's rights, by using the processes of producing yeast and by making, using and selling, or causing to be made, used or sold the yeast product described and claimed in said letters patent.

18. Plaintiff and its said predecessor have given due notice to defendant and to the public of said letters patent so far as required by law, by printing on the wrappers in which its products are manufactured in accordance with the disclosures of said patents, the words "Patented and Manufactured under Processes protected by U. S. Patents issued March 20, 1923," but the defendant, as plaintiff is informed and believes and therefore avers, has continued and is continuing and threatening to continue its infringement as herein alleged.

19. Plaintiff is informed and believes and therefore avers that by reason of said infringements defendant has realized and received large gains, profits and advantages which plaintiff would otherwise have received, and to which plaintiff is rightfully entitled, and has caused plaintiff great and irreparable damage and injury.

WHEREFORE, plaintiff, expressly waiving answer under oath (except as to certain interrogatories which it may hereinafter file) respectfully prays:

First: For a writ of injunction, as well preliminary as permanent, issuing out of and under the seal of this Court, enjoining and restraining said defendant, its officers, directors, servants, agents, clerks, employees and workmen, and all persons acting for, by, or under it, from infringing plaintiff's United States Letters Patent Nos. 1,449,103, 1,449,105, 1,449,106, 1,449,109, 1,449,127, 1,449,134, 1,475,215, 1,673,735 and 1,688,831, and each of them.

Second: For an accounting of the profits, gains and savings realized by defendant, and damages suffered by plaintiff by reason of the infringement of plaintiff's said letters patent and each of them.

Third: That plaintiff recover said profits, gains and savings and damages, together with its costs herein.

Fourth: That plaintiff have such other and further relief as to the Court may seem just and proper.

STANDARD BRANDS INCORPORATED,

By PAUL W. FLEISCHMANN,
Vice President.

WATSON, BRISTOL, JOHNSON & LEAVENWORTH,
Solicitors for Plaintiff.
6 East 45th Street,
New York, N. Y.

L. A. WATSON,
C. V. JOHNSON,
Of Counsel.
6 East 45th Street.
New York City.
ALEXANDER T. SCHENCK,
Solicitor for Plaintiff.

STATE OF NEW YORK,
COUNTY OF NEW YORK, } *ss.:*

PAUL W. FLEISCHMANN, being duly sworn, deposes and says that he is an officer, to wit, the vice-president of Standard Brands Incorporated, the plaintiff in the above-entitled action; that he has read the foregoing complaint and knows the contents thereof, and the same is true of his own knowledge, except as to the matters which are therein stated to be alleged upon information and belief, and that as to those matters he believes it to be true.

Deponent further says that the reason why this verification is made by him is that the plaintiff is a foreign corporation; that the sources of his knowledge and the grounds of his belief as to matters alleged upon information and belief are conversations with officers and employees of plaintiff, with plaintiff's attorneys, and from reports and investigations caused to be made by plaintiff.

PAUL W. FLEISCHMANN. (L. S.)

Sworn to before me this fifteenth day of December, 1932.

MAE DE LA MARCHE,
(Seal) *Notary Public.*
Notary Public, Bronx Co. No. 145, Reg. No. 152-D-33.
Cert. filed in N. Y. Co. No. 713, Reg. No. 3-D-481.
Commission expires March 30, 1933.

ANSWER OF DEFENDANT (AS AMENDED).

(As Filed May 1, 1933 and amended May 8, 1934 and August 20, 1935.)

The above-named defendant, National Grain Yeast Corporation, for answer to the bill of complaint or to so much thereof as is material to be answered, says:

1. Defendant has no knowledge as to whether plaintiff is a corporation organized and existing under the laws of the State of Delaware and having an office and place of business in New York, N. Y., and therefore denies same.

2. Defendant admits that it is a corporation organized and existing under the laws of the State of New Jersey, and has an office and place of business in Belleville, County of Essex, State of New Jersey, but otherwise denies the allegations of paragraph 2 of the bill of complaint.

3. Defendant admits that this is a suit for infringement of United States Letters Patent, but denies that the bill of complaint sufficiently sets forth a cause of action under the patent laws of the United States as to give this Court jurisdiction.

4. Defendant admits that on March 20, 1923 Letters Patent Nos. 1,449,103, 1,449,105, 1,449,106 and 1,449,109 were issued by the United States Patent Office, but defendant otherwise denies the allegations of paragraph 4 of the bill of complaint and specifically avers that each and every claim thereof is invalid and was issued without authority of law and without full compliance with the provisions of the patent statutes in such cases made and provided.

Defendant denies that the said alleged inventions of Friedrich Hayduck were new and useful and not known or used by others in this country before his

invention or discovery thereof, and not patented or described in any printed publication in this or any foreign country before his invention or discovery thereof, or more than two years prior to his respective applications therefor, and not in public use or on sale in this country for more than two years prior to his respective applications for said letters patent, and which have not been abandoned; and defendant further denies that he made applications in due form of law for Letters Patent of the United States for said inventions.

5. Defendant has no knowledge as to the allegations of paragraph 5 of the bill of complaint and therefore denies same.

6. Defendant admits that on March 20, 1923 Letters Patent No. 1,449,127 were issued by the United States Patent Office, but defendant otherwise denies the allegations of paragraph 6 of the bill of complaint and specifically avers that each and every claim thereof is invalid and was issued without authority of law and without full compliance with the provisions of the patent statutes in such cases made and provided.

Defendant denies that the said alleged inventions of Martin Nilsson and Norman S. Harrison were new and useful and not known or used by others in this country before their invention or discovery thereof, and not patented or described in any printed publication in this or any foreign country before their invention or discovery thereof, or more than two years prior to their application therefor, and not in public use or on sale in this country for more than two years prior to said application for letters patent, and which has not been abandoned; and defendant further denies that they made application in due form of law for Letters Patent of the United States for said invention.

7. Defendant has no knowledge as to the allegations of paragraph 7 of the bill of complaint and therefore denies same.

8. Defendant admits that on March 20, 1923 Letters Patent No. 1,449,134 were issued by the United States Patent Office, and that on November 27, 1923 Letters Patent No. 1,475,215 were issued by the United States Patent Office, but defendant otherwise denies the allegations of paragraph 8 of the bill of complaint and specifically avers that each and every claim thereof is invalid and was issued without authority of law and without full compliance with the provisions of the patent statutes in such cases made and provided.

Defendant has no knowledge that the applications on which Patents Nos. 1,449,134 and 1,475,215 were granted were in whole or in part continuations of application for U. S. Letters Patent filed June 23, 1920, Serial No. 391,156, and application for U. S. Letters Patent filed August 31, 1921, Serial No. 497,322, and therefore denies same.

Defendant denies that the said alleged inventions of Alfred Wohl were new and useful and not known or used by others in this country before his invention or discovery thereof, and not patented or described in any printed publication in this or any foreign country before his invention or discovery thereof, or more than two years prior to his said first respective application therefor, and not in public use or on sale in this country for more than two years prior to his said applications for letters patent, and which has not been abandoned; and defendant further denies that he made application in due form of law for Letters Patent of the United States for said inventions.

9. Defendant has no knowledge as to the allegations of paragraph 9 of the bill of complaint and therefore denies same.

10. Defendant admits that on June 12, 1928, Letters Patent No. 1,673,735 were issued by the United States Patent Office, but defendant otherwise denies the allegations of paragraph 10 of the bill of complaint and specifically avers that each and every claim thereof is invalid and was issued without authority of law and without full compliance with the provisions of the patent statutes in such cases made and provided.

Defendant denies that the said alleged invention of Robert L. Corby and Wilhelm H. F. Bührig was new and useful and not known or used by others in this country before their invention or discovery thereof, and not patented or described in any printed publication in this or any foreign country before their invention or discovery thereof, or more than two years prior to their application therefor, and not in public use or on sale in this country for more than two years prior to said application for letters patent, and which has not been abandoned; and defendant further denies that they made application in due form of law for Letters Patent of the United States for said invention.

11. Defendant has no knowledge as to the allegations of paragraph 11 of the bill of complaint and therefore denies same.

12. Defendant admits that on October 23, 1928, Letters Patent No. 1,688,831 were issued by the United States Patent Office, but defendant otherwise denies the allegations of paragraph 12 of the bill of complaint and specifically avers that each and every claim thereof is invalid and was issued without authority of law and without full compliance with the provisions of the patent statutes in such cases made and provided.

Defendant denies that the said alleged invention of Fred Ranschoff was new and useful and not known or used by others in this country before his invention or discovery thereof, and not patented or described in any

printed publication in this or any foreign country before his invention or discovery thereof, or more than two years prior to his application therefor, and not in public use or on sale in this country for more than two years prior to said application, and which has not been abandoned; and defendant further denies that he made application in due form of law for Letters Patent of the United States for said invention.

13. Defendant has no knowledge as to the allegations of paragraph 13 of the bill of complaint and therefore denies same.

14. Defendant has no knowledge as to the allegations of paragraph 14 of the bill of complaint and therefore denies same.

15. Defendant denies the allegations of paragraph 15 of the bill of complaint.

16. Defendant denies the allegations of paragraph 16 of the bill of complaint except that it admits that an opinion of the United States District Court for the District of Maryland, reported in 8 F. (2d) 186; and another opinion reported in 38 F. (2d) 329; and an opinion of the United States Circuit Court of Appeals for the Fourth Circuit, reported in 13 F. (2d) 570.

Defendant avers that neither it nor any of its privies, predecessors or employees was a party to or concerned in or contributed to the defenses of said litigations, and by reason thereof this defendant is not bound thereby, and defendant further avers that the Courts in decreeing as alleged for plaintiff were not fully advised in the premises.

17. Defendant denies the allegations of paragraph 17 of the bill of complaint.

18. Defendant denies the allegations of paragraph 18 of the bill of complaint.

19. Defendant denies the allegations of paragraph 19 of the bill of complaint.

20. As to Patents Nos. 1,449,103, 1,449,105, 1,449,-106, 1,449,109 and 1,475,215, purporting to be granted under the provisions of the Act of March 3, 1921, 41 Stat. L. 1313, defendant, on information and belief, denies that the respective inventors were entitled to the benefits of said Act; further denies that it became effective as to them; further denies that they complied with the requirements thereof; and further denies that said patents were authorized by said Act.

21. As to each of the patents in suit, defendant, on information and belief, denies that each such patent was issued to the true inventor or inventors, or for the same inventions as originally disclosed and claimed, or for the same inventions as the foreign inventors had previously applied for in foreign countries, but avers that new matter was unlawfully added during prosecution and other acts committed during prosecution whereby each and all of said patents is invalid and plaintiff is estopped to seek a broad construction thereof.

22. Defendant further avers that each and all of said patents in suit do not comply with the requirement of the patent laws in that the alleged inventions are incompletely and inaccurately described and that the disclosures are misleading and also insufficient to enable one skilled in the art to carry the alleged inventions into effect, and that said patents were surreptitiously and unjustly obtained for that which was not the invention or discovery of the alleged inventors but which was in fact made by others who were using reasonable diligence in adapting and perfecting the same,

whose names and addresses are not now definitely known to defendant, but which defendant prays leave to insert by amendment or otherwise to this answer after having ascertained the same.

23. Defendant denies the equity of plaintiff's bill of complaint; denies that plaintiff has any right whatever to an injunction preliminary or perpetual, or to an accounting for damages, proceeds, gains, charges or costs to be recovered from this defendant, or any other or further release against this defendant.

24. Defendant further avers that Letters Patent Nos. 1,449,103, 1,449,105, 1,449,106 and 1,449,109 are invalid and void for the reason that the patentee Friedrich Hayduck is not the original inventor of the subject-matter described and claimed therein, but that on the contrary such subject-matter was disclosed to the said Friedrich Hayduck by others, particularly Wilhelm Henneberg, of Kiel, Germany, and other workers at the Berlin Institute for Fermentation Industries, whose names and addresses are not now definitely known to defendant, but which defendant prays leave to insert by amendment or otherwise to this answer after having ascertained the same.

25. Defendant further avers that Letters Patent Nos. 1,449,103, 1,449,105, 1,449,106 and 1,449,109 and each of them, are invalid and void for the reason that each of said patents is directed to the same alleged invention as described and claimed in one or more of the other letters patent issued to the same alleged inventor, including Letters Patent Nos. 1,449,102, 1,449,104, 1,449,107, 1,449,108, 1,449,110, 1,449,111, 1,449,112 and 1,449,113; and defendant further avers that said Patents Nos. 1,449,103, 1,449,105, 1,449,106 and 1,449,109, are invalid and void because there is no patentable distinction between the subject-matter described and

claimed, respectively, in each of said letters patent and the subject-matter described and claimed in the other said patents above enumerated, and no one of said letters patent described and claimed a complete process which is not in whole or in part described and claimed in one or more of said other above-enumerated letters patent.

26. Defendant further avers that Letters Patents Nos. 1,449,103, 1,449,105, 1,449,106 and 1,449,109, are invalid and void for the reason that the specifications of said letters patent do not, as required by the statutes, set forth the best mode for applying the alleged invention, but on the contrary, no commercially useful results can be obtained by following the specific instructions set forth, respectively, in the specifications of said letters patent.

27. Defendant further avers that Letters Patent Nos. 1,449,103, 1,449,105, 1,449,106 and 1,449,109, are invalid and void because prior to the alleged invention by the said Friedrich Hayduck of the alleged improvements therein described and claimed, or more than two years prior to his application for letters patent therefor, the said alleged improvements or all material and substantial part or parts thereof had been patented or described in printed publications, to wit:

UNITED STATES PATENTS.

114,671	Green	May 9, 1871
255,176	Levy	March 21, 1882
1,042,332	Ekstrom	October 22, 1912
1,044,615	Willcox	November 19, 1912
1,201,062	Lavedan	October 10, 1916
Re-10,341	Levy	June 12, 1883
1,475,215	Wohl	November 27, 1923

BRITISH PATENTS.

No. 20,787 of 1892—Polsky
No. 174,625 of 1923—Moskovits
No. 778 of 1880—Lake

GERMAN PATENT.

No. 10,135 of 1879—Rainer

SWISS PATENT.

No. 65,539 of 1913—Pollock

HUNGARIAN PATENT.

No. 77,361 of 1921—Moskovits

FRENCH PATENT.

No. 342,133 of 1904

AUSTRIAN PATENT.

No. 45/4047 of 1895—Fritsche

UNITED STATES PUBLICATIONS.

Journal of the Society of Chemical Industry, Vol. XXVII, 1908, page 415. An article by W. Henneberg.

Journal of the Society of Chemical Industry, Vol. XXVII, 1908, page 1034. An article by F. Hayduck, "Yeast Poison in Cereals."

Pure Products Magazine (New York) 1908, pages 224-229; 1911, pages 157-159.

FOREIGN PUBLICATIONS.

Centralblatt f. Bakt. etc. II Abt. BdXX. No. 89—Original—Contribution. An article by W. Henneberg, Berlin. Pages 225-229.

Centralblatt f. Bakt. etc., Part II, Volume XXII, pages 108-114 (1909). An article by W. Henneberg.

Chemiker Zeitung, 1907, pages 1086-7. Articles by Hayduck and Henneberg.

Chemiker Zeitung, 1908, page 595. An article by F. Hayduck.

Zeitschrift fuer Spiritusindustrie, 41 Jahg. Nr. 43, October 24, 1918. An article by W. Henneberg on pages 403-404.

Wochenschrift fur Brauerei, January 18, 1903, Vol. 20, No. 3, page 25, an article by M. Delbrück.

Presshefe Kunsthefe und Backpulver by Adolf Wilfert, published in 1890 in Vienna, pages 192-195.

Centralblatt f. Bakt. etc. 1914, page 562 of an article by Widar Brenner, starting on page 555, entitled "The Nitrogen Nutrition of Mold Fungi."

28. Defendant further avers that Letters Patent No. 1,449,127 are invalid and void because prior to the alleged invention by the patentees Martin Nilsson and Norman S. Harrison of the alleged improvements therein described and claimed, or more than two years prior to their application for letters patent therefor, the said alleged improvements or all material and substantial part or parts thereof had been patented or described in printed publications, to wit:

The patents and publications cited in the preceding paragraph and in addition thereto, the following United States Letters Patent:

1,449,103—Hayduck—March 20, 1923
1,449,105—Hayduck—March 20, 1923
1,449,106—Hayduck—March 20, 1923
1,449,109—Hayduck—March 20, 1923

29. Defendant further avers that the Nilsson and Harrison Patent No. 1,449,127 is invalid and void because the patentees have unreasonably neglected and delayed to enter a disclaimer of the subject matter described and claimed in said letters patent which was held by the Court of Appeals for the Fourth Judicial Circuit not to be the invention of the said patentees.

30. Defendant further avers that Letters Patent No. 1,449,134 are invalid and void because prior to the alleged invention by the patentee Alfred Wohl of the alleged improvements therein described and claimed, or more than two years prior to his application for letters patent therefor, the said alleged improvements or all material and substantial part or parts thereof had been patented or described in printed publications, to wit:

UNITED STATES PATENT.

1,201,062	Lavedan	October 10, 1916

BRITISH PATENTS.

Elion	17,496	of 1895
Molhant	11,617	of 1913
Graeger	8,795	of 1893

GERMAN PATENTS.

113,977	Marbach	Jan. 3, 1900
23,329	Claudon and Vieguex	Oct. 28, 1882
87,333	Sexauer	Mar. 16, 1895
72,605	Graeger	1893

FRENCH PATENTS.

Coilette & Boidin	318,297	Feb. 1, 1902
Meunier	370,279	Oct. 6, 1906
Roth	470,925	Mar. 30, 1914
Courtonne	214,238	June 17, 1891
Graeger	229,843	May 4, 1893
Bruk vel Brogg and Cuker	436,401	Nov. 15, 1911

DANISH PATENT.

Krach & Nycander	1550	Apr. 12, 1898

PUBLICATIONS.

American Distillers' Review, Vol. 4; 1914; p. 132.

Handbuch der Presshefefabrikation; von Dr. Wilhelm Kiby, edited by Friedrich Viewegt Sohn, Braunschweig, in 1912 (Germany), pp. 510, 511 and 606; 248.

Alkohol, Berlin, of September 30, 1910; Vol. 20, No. 40, page 316.

Delbruck "Illustriertes Brennerei-Lexikon," Berlin, 1915, pages 517; 518; 39, 532 and 540.

Garungsbakteriologische Praktikum; W. Henneberg, Berlin, 1909; pages 28-31; 53 to 56; 288, 289; 305 to 311; 643 and 644.

Zeitschrift fur Spiritusindustrie, Vol. XLV, Nr. 46, November, 1922. An article by Friederich Wendel, "Sugar Cane Molasses."

Brennerei Zeitung, 1919, p. 8351. An article by A. Zscheile.

Brennerei Zeitung, 1922, page 206. An article by F. Wendel.

Brennerei Zeitung. 36 (1919) 8239. An article by G. E. Elrodt.

Die Zuckerindustrie, Vol. 40, pages 650 to 654. An article by F. Hayduck.

31. Defendant further avers that Letters Patent No. 1,673,735 are invalid and void because prior to the alleged invention by the patentees Robert L. Corby and Wilhelm H. F. Bührig of the alleged improvements therein described and claimed, or more than two years prior to their application for letters patent therefor, the said alleged improvements or all material and substantial part or parts thereof had been patented and described in printed publications, to wit:

UNITED STATES PATENTS.

613,149	Jansen	October 25, 1898
1,212,656	Magne	January 16, 1917
1,510,195	Romer	September 30, 1924

BRITISH PATENT.

No. 21011 of 1896—Jacquemin

32. Defendant further avers that each and all of said patents in suit are invalid and void because prior to the alleged invention by the respective patentees of the alleged improvements described and claimed in the said patents, such alleged improvements or all material and substantial parts thereof had been known and used by others within the United States, particularly by the following, to wit:

Name	Residence	Place of use
Robert Wahl	Chicago, Ill.	Chicago, Ill.
M. Henius	Chicago, Ill.	Chicago, Ill.
Robert L. Corby	Newark, N. J.	Washington, D. C.
The Fleischmann Co.	New York City	Peekskill, N. Y., and other plants

and by the several patentees referred to in paragraphs 27, 30 and 31 hereof, at the places of residence stated in their respective patents.

33. Defendant further avers that each and all of said patents in suit are invalid and void because in view of the state of the art at and prior to the date of the alleged invention by the respective patentees of the alleged improvements described and claimed in said patents, and in view of the prior knowledge and practices of others, no exercise of invention is involved in devising the improvements purported to be patented by said letters patent, but on the contrary the same involve merely the exercise and application of the knowledge and skill of the art.

34. Defendant further avers that by reason of the proceedings in the Patent Office which resulted in the letters patent here in suit and each of them, and the admissions, statements and representations therein made by or on behalf of the patentees in order to induce the grant of said letters patent, plaintiff is estopped to claim for such letters patent such construction or interpretation, were the same otherwise pos-

sible, as would cause said letters patent or any of them to be infringed by any process used or article made, used or sold by this defendant.

35. Defendant further avers that said letters patent here in suit and each of them, if construed broadly enough to include and be infringed by any process or article made, used or sold by this defendant, are invalid and void because the processes used by this defendant involve no departure from the processes of making yeast generally used in this country and in other countries since long prior to the application dates of any of said letters patent, except such improvements as have resulted from the expected development of the art and the obvious application thereto of scientific facts and principles as developed in the progress of the art.

NATIONAL GRAIN YEAST CORPORATION,
Defendant.

By WALTER G. WINNE,
Solicitor for Defendant,
210 Main St.,
Hackensack, N. J.

CONWAY P. COE,
800 National Press Building,
Washington, D. C.

JULIAN S. WOOSTER,
233 Broadway, New York.
Of Counsel.

DEFENDANT'S MOTION FOR AN ORDER AMENDING ANSWER AND REOPENING PROOFS.

(Filed March 2, 1935.)

Comes now defendant, and moves for an order.

1. That the answer be amended, by adding to paragraph 27, as a defense against the Hayduck Patent 1,449,105, the German patent to Kamienski, No. 269,192 of 1912, copies of said patent and of a translation thereof being attached hereto.

2. That defendant's proofs be reopened, to add a copy of the translation of said Kamienski patent to Defendant's Exhibit D-1, Book of References, and a copy of said patent to Defendant's Exhibit D-2, Book of Foreign Patents and Publications.

3. That defendant shall not offer any testimony regarding said patent, nor assert that it discloses more than was stated in *Standard Brands v. Federal Yeast*, 38 F. (2d) 329, 337, namely:

> "The German patent to Kamienski of 1912 covers a process for the preparation of pressed yeast. The gist of the patent is a second seeding of pitching yeast which is added along with concentrated wort while the fermentation is not yet finished. The patent does disclose the addition of a concentrated to a highly diluted portion of the wort, but there is no indication as to the rate of addition; nor does it appear that the feeding process is continuous or the concentration constant."

That in lieu of other leave to plaintiff to offer testimony regarding said patent, the following testimony of plaintiff's witness Dr. A. B. Lamb given in said case of Standards Brands Incorporated v. Federal Yeast Corporation be considered as also given by

him on behalf of plaintiff in this case and be incorporated in the transcript of evidence herein,

"In other words, this process of starting fermentation in a portion of a concentrated wort in a propagating vat and then running into that fermenting liquid further concentrated wort is nothing other than is referred to specifically in one of the Hayduck patents which I might refer to in this connection, namely, Patent '105, page 2, lines 38 and thereafter, where it states:

> 'In the manufacture of compressed yeast, the starting of the primary, undiluted wort with yeast, and the adding of the secondary wort, which is being constantly diluted, is a known method, the concentrated wort from the mash process being filtered from the draff and led into the fermenting vat.'

It seems to me this describes reasonably well the process that this patent to Kamienski has been carrying through, except, of course, for the peculiar variations in temperature which this patent recommends, which I won't take the time to go into.

It seems to me also that the concluding sentence in the patent claim describing the operation also indicates that the addition of the retained third of the first wort is made without any special delay or in any specially prolonged fashion, because after describing the preliminary steps in the process he says, referring to the last lines of the translation, on page 3:

> 'Whereupon to this fermented wort the retained third of the pitching yeast, which has just begun to ferment,'

or, as I see it is corrected:

> 'Just fermenting, the retained third of the first wort is added and the whole is then fermented out in the known manner.'

In any case, there is no indication that in this addition there is any regulation of the rate of addition. There is no indication that the addition of this concentrated wort is made in such a way as to maintain the optimum concentration in the wort of the yeast nutrient, so that the yeast can flourish to the best of its capabilities, nor is there any appreciation of the other requirement as given in the Hayduck disclosure of a proper co-relation between the amount of nutrient material and the total size and the total bulk of the wort. As I have outlined before, if a too-concentrated nutrient solution is fed in to maintain a low concentration in the nutrient liquid in the vat, undesirable results may occur, as the yeast accumulates in large amounts, so that there may be an overcrowding of the yeast if the precautions as stated by Hayduck are not taken. None of this is mentioned in this patent."

STEPHEN H. PHILBIN,
Counsel for Defendant.

Consented to:

L. A. WATSON,
Counsel for Plaintiff.

February 14, 1936.

The following papers were attached to this motion:

Translation of Kamienski German Patent No. 269,192.

(Printed in Defendant's Exhibit D-1, in Volume II of this record.)

Kamienski German Patent No. 269,192. (Not Printed. Produced in Defendant's Exhibit D-2, Physical Exhibit.)

AGREED STATEMENT OF FACT.

(Submitted February 28, 1936.)

1. The corporate capacities of the parties are as alleged in the bill of complaint.

2. The Court has jurisdiction of the parties and of the issues.

3. The patents in suit 1,449,103, 1,449,105, 1,449,-106 and 1,449,109 were issued March 29, 1923 and 1,673,735 was issued June 12, 1928. The patents in suit have at all times since their issuance been owned by the plaintiff or its predecessor, The Fleischmann Company, which latter duly assigned the same to the plaintiff (Standard Brands Incorporated or The Fleischmann Company, or both, will be referred to hereinafter as plaintiff without distinction).

4. *Chemical Principles*—An acid, for example, sulphuric acid, will combine with a base, for example, aqua ammonia, to form a salt. In the case of the examples, the salt would be ammonium sulphate. A salt may be either exactly neutral or somewhat acid or somewhat basic in its reaction in pure water solution depending on the relative strengths of its acid and basic components. Ammonium lactate is a very nearly neutral salt.

5. *Yeast Principles*—Yeast is a unicellular organism which under favorable conditions grows and buds, the buds splitting off to form new cells likewise capable of growth and production of new cells. Yeast propagation is conducted in a solution of water and nutrients which provide carbon, nitrogen, phosphorus and other materials. During the operation of yeast propagation, the yeast consumes certain of the nutrient materials from the solution. Nitrogen from cereals and

molasses is often termed organic nitrogen and nitrogen from ammonium salts and aqua ammonia is often termed inorganic nitrogen.

The proportion of water to the solids in the nutrient solution may be varied, and this variation changes the concentration of the solids or the dilution of the solution. The concentration of the solids is usually measured on a Balling scale, the degree Balling representing approximately the per cent. concentration of solids on the basis of sugar. So far as shown by the present record commercial yeast manufacture has been conducted with an acid nutrient solution, and the acidity of such solution has been recognized as desirable.

The container for the nutrient solution in which the yeast propagation is conducted is called a propagating vat or, more loosely, a fermenter. The nutrient solution may be spoken of as a wort, or mash. A straight set operation is one in which the nutrient solution is all added to the propagating vat at the start and in such an operation the Balling of the solution, on a yeast free basis, decreases during the propagating period.

As shown in the present record, commercial manufacture by plaintiff of yeast in the United States prior to 1919 was so conducted that both yeast and alcohol were produced in quantity. The portion of the nutrient material which went into the final alcohol yield did, of course, not go into the final yeast yield. It was generally known that alcohol yield was at the expense of yeast yield.

6. *Patent 1,449,103*—This patent states,

> "This invention relates to a process for the manufacture of yeast, particularly bakers' yeast, by propagation in a solution containing sugar material and yeast nourishing inorganic salts.

"An object of this invention is to provide a procedure for the manufacture of yeast on a large scale commercially, there being added to the nutrient solution which contains sugar material and yeast nourishing inorganic salts a neutralizing agent for neutralizing the deleterious excess of acidity." (P. 1, ll. 11-22.)

"It is known that there can be added to mashes in lactic fermentation, nitrogen-supplying antacid-substances, as for instance ammonia, ammonium carbonate or ammonium carbamate, for the partial neutralization of the lactic acid progressively formed and for the augmentation of the yeast-assimilable nitrogen content of the mashes so that they may be utilized for subsequent yeast propagation." (P. 2, ll. 51-61.)

The patent gives an example of a "suitable yeast nutrient solution" containing sugar, ammonium sulphate, ammonium phosphate, and other salts. Calcium carbonate is a salt having an alkaline reaction and is the antacid or neutralizing agent referred to in the example. It is also stated that ammonium carbonate is both a suitable neutralizing agent and a source of assimilable nitrogen for the yeast. The patent also gives molasses as a suitable source of sugar.

Claims 1, 2, 3, 4, 7, 8, 9, 10, 11, 12, 13, 14 and 15 are in suit; of these claims 1, 2, 3, 4, 7, 8, 12, 13, 14 and 15 were in suit and held valid in prior litigation reported in 8 F. (2d) 186, 13 F. (2d) 570 and 38 F. (2d) 314.

7. *Patent 1,449,105*—This patent states,

"This invention relates to a process for the manufacture of yeast and particularly to a process for manufacturing a compressed bakers' yeast in which very little alcohol is produced as a by-product, and has for its object an improved procedure for manufacturing yeast in a more convenient and economical manner than heretofore." (P. 1, ll. 10-17.)

"It has therefore already been suggested to dilute the wort to such an extent that the alcohol produced from the sugar could supposedly again be assimilated by the yeast as nourishment. The process disclosed in the German patent to Rainier, 10,135, endeavors to reach this goal by adding the nutrient required for the yeast (sugar and peptone), in a manner which would produce this result, i. e., by adding the peptones continuously and the sugar at intervals, as required, and whenever analysis showed the need thereof, stating that in keeping the concentration of the sugar very low the formation of alcohol is prevented and the sugar is used only as a nutrient." (P. 1, ll. 28-44.)

"In the process described hereinafter and forming the subject of this invention, the goal of obtaining a high yeast yield with little or no formation of alcohol is reached by the use of worts of normal quality and concentration, the wort being added to the yeast continuously and at a rate such that no large excess of alcohol will be formed, and the yeast can assimilate most of the alcohol which is so formed." (P. 1, ll. 54-63.)

The patent states an example of the procedure as

"A wort adapted for yeast propagation (having, for example, a gravity of 12° Balling) is prepared according to the procedure commonly followed in the compressed yeast industry. A part of this wort is placed in the fermenting vat and is highly diluted (for example, to about 1° Balling), yeast is added thereto and it is aerated. Thereupon the remainder of the concentrated wort is added slowly and substantially continuously throughout a protracted period of time and at a rate such that not only the alcohol which may have been formed from the quantity of sugar present in the diluted portion of the wort, but also any alcohol which may be formed from the sugar which is present in the added wort, can be assimilated immediately by the yeast. If arrangements are made to carry on the aeration process for ten

hours, the addition of the wort may be effected for about seven to eight hours under continuous aeration and the aeration may be subsequently continued for two or three hours without the addition of any wort. The quantity of the diluted wort which is originally available for the yeast is so chosen, for example, that the mean content of the entire wort employed would be 3° to 5° Balling.

"As compared with the obtaining of yeast from worts of very small concentration, the process described above offers the advantage that the yeast is constantly given new supplies of all nutrient constituents necessary for its propagation by the continuous addition of concentrated wort, and that thereby as a result of the continual consumption of the nutrients by the yeast, there is always a wort concentration, by means of which the nutrients and the resultant substances are absorbed most efficaciously and quickly by the yeast, that is to say, there is offered in this manner of procedure through the peculiar distribution of the wort, the advantage of great dilution, while the concentration of the wort (calculated for the entire quantity) remains normal." (P. 1, l. 66 to p. 2, l. 8.)

All the claims of this patent are in suit and of them claims 4, 8, 9 and 10 were held valid in prior litigation reported in 38 F. (2d) 329.

8. *Patent 1,449,106*—The process of this patent is one combining the process of patent '103, including neutralization, and the process of patent '105, including regulated nutrient feed.

Claims 1, 3, 4, 5, 6, 8, 12, 13 and 15 are in suit and of these claims 1, 3, 4, 5, 6, 8, 12 and 13 were held valid in prior litigation reported in 38 F. (2d) 329.

9. *Patent 1,449,109*—The process of this patent combines the process of patent '103, including neutralization, and the process of patent '105, including reg-

ulated nutrient feed, with the additional factor of supplying a substance having an alkaline reaction and containing assimilable nitrogen, by feeding it into the fermenter during the propagating period.

All the claims of the patent are in suit.

10. *Patent 1,673,735*—The patent states,

"In its more specific aspects one of the objects of this invention is to provide a method of carrying out a process of manufacturing yeast in which the amounts of the added constituents are regulated in such a manner that the capacity of fermenters and other propagating apparatus is materially increased and large yields of yeast are obtained." (P. 1, ll. 12-19.)

"In the practice of the present invention, an environment is created and substantially maintained which is favorable to the propagation of large yields of yeast, at the same time using smaller apparatus than was heretofore possible with the use of the very dilute nutrient solutions now generally deemed preferable." (P. 2, ll. 4-11.)

"As propagation is here instituted under conditions particularly favorable to large yields of yeast, certain of the starting conditions are, in accordance with the practice of this invention, periodically approximately restored at intervals whenever such undesirable conditions are reached. For example, fluctuation in the acidity may be compensated from hour to hour by the addition of suitable antacid reagents, particularly those containing yeast assimilable nitrogen, and at intervals generally of several hours, 'addition' is diminished or stopped, a substantial portion of the content of the fermenter is withdrawn and thereafter water, both warm and cold, is again added to the fermenter until certain of the starting conditions, particularly dilution, are substantially restored." (P. 2, ll. 111-129.)

"The interval at which yeast is to be drawn off, will, of course, preferably be some sub-multiple

of the total period of propagation, such as for example, from 4 to 6 or 8 hours as conditions warrant.

It will be perceived that by this intermittent drawing off, fermenters of less total capacity may be employed than was heretofore possible, for a given yield of yeast." (p. 3, ll. 12-20.)

"For example, in a total fermentation time of 14 hours, no addition is made during the seventh hour or during the last hour and the rate of addition is considerably diminished during the sixth hour. Moreover, between the stage of the propagation period, for example, during the seventh hour while the 'addition' has ceased, aeration is diminished and the yeast containing solution is withdrawn from the fermenter until for example about 10-70% of the quantity present at the end of the preceding hour remains, the withdrawal being regulated in accordance with the salt concentration of the liquid in the fermenter. The yeast containing solution thus withdrawn may be immediately separated and if desired a portion of the separated yeast may be returned to the fermenter to act as seed yeast for the next succeeding stage or if desired the withdrawn solution may be used in a subsequent stage of propagation in a manner similar to the use of the residue in the fermenter." (p. 3, l. 113 to p. 4, l. 6.)

"In one aspect, therefore, the process may be considered as comprising the preparation of a yeast nutrient solution, the initiating of propagation of yeast with aeration in a diluted portion thereof, slowly and substantially continuously adding thereto yeast-nutrient materials to supply the deficiencies of the solution and including material to control the acidity, periodically concurrently diminishing or interrupting the addition of nutrients, lowering the aeration and withdrawing a portion of the yeast containing liquid, and thereafter diluting the residue thereof with suitably tempered water and then continuing the propaga-

tion with resumption of higher aeration and addition of nutrients." (p. 4, ll. 44-60.)

Claims 1, 5, 6, 10, 13, 14, 17, 18 and 21 are in suit.

11. *Defendant's Operations Complained of*—Plaintiff's Exhibits 13, 14 and 15 are respectively copies of records of defendant's typical operations of September 12-15, 1931, April 25-27, 1931 and December 7-9, 1932. These records and supplemental data regarding them were supplied in response to plaintiff's interrogatories.

In all these operations, defendant used as raw materials cereal material, aqua ammonia, molasses, and inorganic ammonium salts, namely, ammonium phosphate and ammonium sulphate.

In all of these operations, there was a preliminary souring treatment, the cereal material being soured with lactic acid bacteria, producing lactic acid. This treatment was preliminary to the use of the cereal materials during the propagation of the yeast in the propagating vats.

With respect to the September, 1931 operations (Exhibit 13), no aqua ammonia was used during the preliminary souring treatment. About seven pounds of ammonia per thousand pounds of combined cereals and molasses used were added to the reserve wort and converted to ammonium lactate, prior to propagation. About eight pounds of aqua ammonia per thousand pounds of combined cereals and molasses used were added directly to the propagating vats during the propagation. The ammonium sulphate used was about twenty-three pounds per thousand pounds of combined cereals and molasses used. The mono-ammonium phosphate used was about seventeen pounds per thousand pounds of combined cereals and molasses used.

With respect to the April, 1931 operations (Exhibit 14), defendant added aqua ammonia during the preliminary souring treatment only, adding about twenty

pounds of aqua ammonia per thousand pounds of combined cereals and molasses used, which aqua ammonia was converted to ammonium lactate. The ammonium sulphate used was about twenty pounds per thousand pounds of combined cereals and molasses used. The mono-ammonium phosphate used was about eighteen pounds per thousand pounds of combined cereals and molasses used.

With respect to the December, 1932 operations (Exhibit 15), defendant added aqua ammonia during the preliminary souring treatment only, adding about sixteen pounds per thousand pounds of combined cereals and molasses used, which aqua ammonia was converted to ammonium lactate. During propagation, several additions of di-ammonium phosphate were made to the propagating vats, the total amounting to about fourteen pounds per thousand pounds of combined cereals and molasses used. The ammonium sulphate used was about twenty pounds per thousand pounds of combined cereals and molasses used. The mono-ammonium phosphate used was about eight pounds per thousand pounds of combined cereals and molasses used.

In all the additions of aqua ammonia before propagation, the aqua ammonia reacted with a portion of the lactic acid to form ammonium lactate, the amount of aqua ammonia being insufficient to neutralize all of the lactic acid and leaving an acid solution, which was subsequently fed with the reserve wort into the propagation vats at the different rates respectively shown by these exhibits.

In all of the operations shown by Plaintiff's Exhibits 13, 14 and 15, defendant began propagation in a diluted fraction of the wort at from 1 degree to 1.4 degree Balling and thereafter added the more concentrated reserve wort at regulated rates during the prop-

agation, as shown by the exhibits (Plaintiff's Exhibits 13, 14 and 15). In all these operations, the quantity of the initial dilute wort in the propagating vat at the start bore such a relation to the quantity of the more concentrated reserve wort for later addition into the vat that the mean density of the two quantities was between 3 degrees and 5 degrees Balling, while the actual density in the propagating vat during propagation was as shown on the exhibits and ranged from 1 degree Balling or slightly above at the start to a maximum of about 2.3 degrees Balling (on a yeast-present basis) at the end.

In all of these operations of defendant, yeast yields of between 60 per cent. and 70 per cent. on the raw materials were obtained without any significant amount of alcohol.

In defendant's operations in December, 1932 (Plaintiff's Exhibit 15), it used three vats instead of one in propagating yeast. Nutrients and reserve solution were added to each of the three vats during the propagating. In one series of runs (Mash Sheets 3539, 3540 and 3541), the propagation was begun at a concentration of 1.3 degrees Balling in two wooden vats (Mash Sheets 3539 and 3540) and continued for 7¼ hours, water being added during the last 1½ hours of this period. About half of the propagating liquid in each of these vats was removed and combined in an iron vat (Mash Sheet 3541), water being added to each of the three portions of the propagating liquid until it was diluted to or slightly above its initial Balling. Thereafter propagation was resumed in each of the three vats and completed in about 5½ hours in each of the two wooden vats, and in about 6¾ hours in the iron vat.

In the second series of runs (Mash Sheets 3542, 3543 and 3544), the same procedure was followed except that the initial propagation in the two wooden vats

was carried out for 8 hours, water being added during the last 1½ hours, and, after separating, combining and diluting as before, the propagation was completed in about 6½ hours in the two wooden vats and in about 8 hours in the iron vat.

12. *Prior Art*—Defendant relies, with respect to the feature of neutralization in the three Hayduck patents 1,449,103, '106 and '109 and the Corby et al. patent 1,673,735, on the following references:

Lavedan, 1,201,062
Polsky, British patent, 20,787 (1892)
Jacqueman, British patent, 21,011 (1896)
Molhant, British patent, 11,617 (1913)
Roth, French patent, 470,925
Pollak, Swiss patent, 65,539
Fritsche, Austrian patent 45/4047
Abstract, Henneberg article (1908), (J. Soc. Chem. Ind.)
American Distillers Review (1914)
Pure Products Magazine (1908)
Wilfert article (Presshefe Kunsthefe und Backpulver, 1890)
Brenner article (Centralblatt f. Bakt. 1914)

Of these, Jacqueman, Abstract of Henneberg article, American Distillers Review, Wilfert and Brenner were neither in evidence nor cited in the answers in the first or second Federal Yeast suits. Polsky and Fritsche were not offered in evidence, but were cited in the answer in the second Federal Yeast suit. Lavedan was pleaded in the first Federal Yeast suit and Roth was pleaded in the second Federal Yeast suit by defendant against patents not here in suit, but were not offered in evidence in either suit. The abstract of the Henneberg article is stated on its face to be an abstract of the original complete Henneberg articles in Wochen-

schrift für Brauerei, which original articles were in evidence in both the Federal Yeast suits.

Defendant relies, with respect to the feature of so-called regulated feed in the three Hayduck patents 1,449,105, '106 and '109 and the Corby et al. patent 1,673,735, on the Rainer German patent 10,135, Iwanowski article, Journal Society Chemical Industry, 1903, Delbruck article (Wochenschrift für Brauerei, 1903) and Lafar (Handbuch der Technischen Mykologie, 1907). All these references were in evidence in the second Federal Yeast case and Rainer and Iwanowski were in evidence in the first Federal case.

STIPULATION AS TO PRICES AND DEFENDANT'S OBJECTION THERETO.

(Filed December 22, 1937.)

Subject to the following objection by defendant, counsel for the parties hereby stipulate:

That Mr. Luce, if called on behalf of the plaintiff, would testify that the following are typical average prices in the United States for the commodities and years indicated:

Year	Corn (56# bu.)	Barley Malt (34# bu.)	Molasses (gal. 11.7#)	Alcohol (proof gal.)
1890	$0.395	$0.61	0.10	0.191
1891	0.574	0.71		0.266
1892	0.450	0.61		0.227
1893	0.396	0.57		0.248
1894	0.433	0.61		0.233
1895	0.396	0.53		0.126
1896	0.258	0.40		0.111
1897	0.255	0.42		0.098
1898	0.314	0.54		0.124
1899	0.333	0.54		0.169
1900	0.381	0.58		0.156
1901	0.497	0.69		0.194
1902	0.597	0.73		0.167
1903	0.461	0.65		0.161
1904	0.505	0.63		0.181
1905	0.501	0.59	0.095	0.178
1906	0.463	0.61		0.197
1907	0.528	0.87		0.229
1908	0.684	0.85		0.288
1909	0.688	0.69		0.278
1910	0.581	0.77	0.12	0.244
1911	0.590	1.18		0.234
1912	0.686	1.03	0.10	0.252
1913	0.625	0.69		0.215

Year	Corn (56# bu.)	Barley Malt (34# bu.)	Molasses (gal. 11.7#)	Alcohol (proof gal.)
1914	0.695	0.70	0.11	0.244
1915	0.730	0.82		0.248
1916	0.825	0.99	0.16	0.302
1917	1.637	1.51		0.887
1918	1.605	1.89	0.28	0.41
1919	1.597	1.35		0.356
1920	1.414	1.35	0.10	0.584
1921	0.580	0.72		0.312
1922	0.623	0.70	0.12	0.279
1923	0.821	0.80		0.297
1924	0.972	0.94	0.20	0.327
1925	1.038	0.93	0.21	0.357
1926	0.759	0.79	0.08	0.355
1927	0.882	0.94	0.07	0.206
1928	0.977	0.93	0.058	0.322
1929	0.996	0.77	0.11	0.347
1930	0.827	0.79	0.12	0.292
1931	0.531	0.79	0.07	0.217
1932	0.313	0.76	0.05	0.213
1933	0.408	0.93	0.06	0.213
1934	0.652	1.18	0.06	0.257
1935 (Part of)	0.855	1.21	0.072	0.40

Dated this day of , 193 .

CLAIR V. JOHNSON,
Counsel for Plaintiff.

Dated this day of , 193

STEPHEN H. PHILBIN,
Counsel for Defendant.

DEFENDANT'S OBJECTION.

Defendant objects to the offer in evidence of the above price lists or any part thereof because they are meaningless and without any materiality in this case, but have made the above stipulation at plaintiff's request and without agreeing to the accuracy of the figures.

STEPHEN H. PHILBIN,
Counsel for Defendant.

NARRATIVE STATEMENT OF EVIDENCE.

(Filed March 29, 1938.)

IN THE DISTRICT COURT OF THE UNITED STATES,
FOR THE DISTRICT OF NEW JERSEY.

No. 4552. IN EQUITY.

Standard Brands Incorporated,
Plaintiff,

v.

National Grain Yeast Corporation,
Defendant.

Newark, N. J., Tuesday, October 16, et seq., 1935.

FINAL HEARING.

Before: HON. GUY L. FAKE, *U. S. D. J.*

Appearances:

ALEXANDER T. SCHENCK, ESQ., solicitor for plaintiff;

MESSRS. WATSON, BRISTOL, JOHNSON & LEAVENWORTH, by L. A. WATSON, ESQ., and C. V. JOHNSON, ESQ., of counsel;

MESSRS. WINNE & BANTA, solicitors for defendant, by JOHN A. CHRISTIE, ESQ.;

MESSRS. PENNIE, DAVIS, MARVIN & EDMONDS, by W. B. MORTON, ESQ., and H. STANLEY MANSFIELD, ESQ., of counsel;

MESSRS. FISH, RICHARDSON & NEAVE, by STEPHEN H. PHILBIN, ESQ., and PAUL R. AMES, ESQ., of counsel.

PLAINTIFF'S PROOFS.

MR. WATSON: Plaintiff offers in evidence as Plaintiff's Exhibit 1, under the stipulation permitting the use of printed Patent Office copies, a copy of United States Patent 1,449,103, issued March 20, 1933.

(Received in evidence and marked Exhibit P-1.)

MR. WATSON: I offer as Plaintiff's Exhibit No. 2 a copy of United States Patent 1,449,105, issued March 20, 1923.

(Received and marked Exhibit P-2.)

MR. WATSON: And as Plaintiff's Exhibit 3 a copy of the United States Patent 1,449,106, issued March 20, 1923.

(Received and marked Exhibit P-3.)

MR. WATSON: And as Plaintiff's Exhibit 4 a copy of United States Patent 1,449,109, issued March 20, 1923.

(Received and marked Exhibit P-4.)

MR. WATSON: And as Plaintiff's Exhibit 5 a copy of United States Patent 1,673,735, issued June 12, 1928.

(Received and marked Exhibit P-5.)

MR. WATSON: I offer as Plaintiff's Exhibit 6 a certified copy of the file wrapper and contents in the matter of the United States Patent 1,449,103.

(Received and marked Exhibit P-6.)

MR. WATSON: I offer as Plaintiff's Exhibit 7 similar certified copy of the file wrapper and contents of United States Patent 1,449,105.

(Received and marked Exhibit P-7.)

MR. WATSON: I offer as Plaintiff's Exhibit 8 similar certified copy of the file wrapper and contents concerning United States Patent 1,449,106.

(Received and marked Exhibit P-8.)

MR. WATSON: I offer as Plaintiff's Exhibit 9 similar certified copy of the file wrapper and contents of United States Patent 1,449,109.

(Received and marked Exhibit P-9.)

MR. WATSON: I offer as Plaintiff's Exhibit 10 certified copy of the file wrapper and contents of United States Patent 1,673,735.

(Received and marked Exhibit P-10.)

MR. WATSON: I offer as Plaintiff's Exhibit 11, a consolidation of plaintiff's interrogatories and defendant's answers.

(Received and marked Exhibit P-11.)

MR. WATSON: I offer as Plaintiff's Exhibit 12 statement of supplemental facts of defendant's operations given by defendant's counsel.

(Received and marked Exhibit P-12.)

MR. WATSON: I offer as Plaintiff's Exhibit 13 original copy of defendant's mash sheet of September 12 to 15, 1931, with its commercial flow sheets M559 to M561 inclusive, and two related seed flow sheets of September 15, 1931.

(Received and marked Exhibit P-13.)

MR. WATSON: I offer as Plaintiff's Exhibit 14 photostat of defendant's mash sheet of April 25 to 27, 1931, with commercial flow sheets M177 to M180 of April 27, 1931.

(Received and marked Exhibit P-14.)

MR. WATSON: I offer as Plaintiff's Exhibit 15 a photostat of defendant's mash sheet of December 7 to 9, 1932, with its commercial flow sheets 3539 to 3544 and one related flow sheet of December 9, 1932.

(Received and marked Exhibit P-15.)

ARTHUR B. LAMB, called and sworn for the plaintiff, testified as follows:

DIRECT EXAMINATION BY MR. WATSON:

THE WITNESS: I reside in Brookline, Massachusetts, 121 Colbourne Crescent. I am professor of chemistry at Harvard University, Cambridge, Massachusetts, and director of the Chemical Laboratory of Harvard University.

I first studied at Tufts College, near Boston, and received there the degrees of bachelor of arts and master of arts, specializing up to that point in biology, and receiving my master's degree for work done in that subject. I then continued with the study of organic chemistry at Tufts College and received the degree of doctor of philosophy at that institution. I then went to Harvard University and studied physical chemistry, and later received a degree of doctor of philosophy at Harvard in that subject. The following year, or a year and a half, I spent in further study at the Universities of Leipsig and Heidelberg in Germany. Since that time I have been a teacher most of the time. I received the additional degree, honorary degree, of doctor of science from Tufts College a few years ago.

I am a member of the American Chemical Society and was president of that society a few years ago. I am acting at present as editor of the journal published by that society. I am also a member of the American Academy of Arts and Sciences, the Washington Academy of Sciences and of the National Academy of Arts and Sciences. I am a member of the German Chemical Society and the German Electrochemical Society.

The patents here in suit which I have read and understand, broadly considered, deal with the commercial manufacture of yeast, particularly baker's yeast.

I acted as an expert in the litigation in which these patents were concerned, at Baltimore, in Judge Soper's

court. That was, if I remember rightly, a good while ago, ten years or more.

Baker's yeast is a product that I think is familiar to us all, either in its form as used in the home, or by bakers, as a soft, crumbly material, light tan in color. If this material is rubbed with water, it becomes, or at least it gives rise to a milky fluid, and if this is looked at under a strong microscope one can see that the yeast consists of a multitude of very minute little round objects or cells. These cells are perhaps less than a thousandth of an inch in diameter. They are semi-transparent as seen under the microscope, not always perfectly spherical, perhaps oval in shape occasionally, usually. They have a thick outer portion, as one can detect under the mieroscope, that is a cell wall. In other words, they are little uni-cellular organisms, as distinguished from the multi-cellular organisms which we are familiar with in the higher plants and animals. Baker's yeast is used largely in the preparation of bread and similar foodstuffs. Its object, as every one knows, is to make bread lighter and more open in its texture, to act as a leavening agent on the bread, making it lighter and also more palatable.

By THE COURT: Yeast, I suppose, is referred to in the Scriptures when we read of unleavened bread. They must have known something of yeast then. Could you briefly outline the history of it, as far as it is actually known?

Well, I don't know that there are accurate historical records that would justify any rigid statement about yeast of that time, but doubtless they used liquid yeast—that is, they used materials in which yeast would grow and in which yeast was growing. One doesn't go back very far to find yeast in its present form as used in the household; it is a matter of a hundred years since yeast was sold in anything like its present solid

form. The yeast used by the baker is very similar to the little two-cent yeast cake you used to buy. It differs largely in the way it is packaged. I think we have here in court a sample of the substance bakers use.

MR. WATSON: I can show you a pound of yeast.

Q. 16. Now, how, Dr. Lamb, does the yeast get its nutrient, how is it propagated in manufacture?

A. The yeast we sell has to derive its food or nutriments from dissolved material in the water in which it is present or from the solution, as we would speak of it. This dissolved material makes its way through the cell wall that I spoke of and is utilized inside of the little cell in the manufacture of cell substance. In the growth of the yeast it absorbs, in other words, these materials out of the nutrient solution in which it is present.

THE COURT: Is it animal or vegetable?

THE WITNESS: It is usually spoken of as vegetable.

A. (Continuing.) In absorbing this added nutriment and in growing additional living substance within the cell, it increases in size and it in consequence frequently forms a bud or swelling on the inside of the cell. This bud or swelling increases and as growth continues will split off from the parent cell and we will have two yeast cells from the original single cell, so that propagation of this yeast is by splitting and the yeast bud cell again splitting. The smaller cells, of course, increase in size and as they absorb nutriment from the solution, ultimately, if additional food and favorable conditions are available, they will undergo another subdivision to form granddaughter cells, etc.

The yeast that is grown in processes, for instance, as illustrated by Plaintiff's Exhibit 1, this '103 patent, is started from a nutrient solution in which it has been

growing and after suitable treatment is usually compressed or formed into cakes and makes the familiar small cakes that are used domestically or the larger cake that has been exhibited, or the larger cakes can be cut up into small cakes, etc. This is compressed yeast as contrasted with a suspension of yeast in water or a wet yeast product.

Propagation, in yeast manufacture, is used in what I think is its usual sense, namely, that the yeast multiplies and grows. This process of subdivision which I have spoken of would be propagation of the yeast.

Nutrient solution is a convenient term to employ for this liquid, usually water, in which the yeast foods are dissolved. It is the nourishing liquid in which the yeast propagates and flourishes.

One of the requirements of yeast, at least for its rapid growth, is a plentiful supply of air and this is secured by drawing air through the liquid in which propagation is taking place. The liquid is thus aerated and the process is spoken of as aeration.

By THE COURT:

Q. 22. Do I understand that yeast is manufactured or compounded or what would you call it, Doctor, what is it, made?

A. Manufactured is a very good expression.

Q. 23. By taking yeast and planting it, so to speak, in water and that water having favorable ingredients in it, is that the way it is made?

A. That is an apt statement of the process.

Q. 24. So that in the absence of any yeast planted we could not make it, is that correct?

A. Quite true, although that conclusion was one that took a good many years to reach because in the early days it was difficult to sterilize the air and the liquid sufficiently so that some yeast seed, some minute little particle of yeast was not present and early investigators were misled frequently to think——

Q. 25. I once heard, I think it was during the days of Prohibition, that although a brewer had given up brewing beer he continued to grow yeast or manufacture yeast, to the end that he might not lose it in event that the Prohibition laws were repealed.

A. Yes, as I think will perhaps come out later in the litigation, there are varieties of yeast and there are desirable breeds of yeast just as there are desirable——

Q. 26. In that case I gathered that there was a particular yeast.

A. Yes.

Q. 27. And that it was different from other yeasts, had its effect in brewing beer, and they wanted that particular yeast, so they kept it alive all these years?

A. Yes, that is true, that is a desirable thing to do particularly perhaps more in the manufacture of certain wines where——

Q. 28. Wines will produce it, won't they?

A. Yes.

Q. 29. In the manufacture of wine there will be yeast as a sediment, will there not?

A. Well, yes. The yeast actually functions in the manufacture of wines and beers, it grows and ferments the sugar to form alcohol, to produce the alcohol. That is the important ingredient of the wine and the beer.

Q. 30. It appears now then that yeast must be obtained with which to produce additional yeast. I have before me here five patents. I assume then that each of those patents has to do with the taking of yeast and producing more yeast through the process, and each patent of the patents in suit is a process and each of them based upon the production of yeast to plant, so to speak, in the solution to produce more yeast; is that correct?

MR. WATSON: That is correct; each of them refers to the process of manufacturing yeast on a large commercial scale. Of course, your Honor, as you can appreciate, there is perhaps an infinity of range in the selection of the materials and control of conditions, etc., of the things in the nutrient solution and the process of propagation, and these patents are directed to processes wherein special materials are employed, special ingredients and special procedure. That is another way of stating it. Your Honor inquired what we referred to as the seed yeast as distinguished from the manufactured end product.

THE COURT: I suppose you would call it seed but I hadn't thought of it in that way, while I did refer to its being planted.

MR. WATSON: That is the common expression, of "seed yeast."

THE COURT: Yes, I asked about that; I think the doctor has answered that. You see what I want to get clear is whether or not you have to have yeast to produce more yeast; in other words, you haven't anything here in these patents by which yeast may be produced except by planting it, so to speak?

MR. WATSON: By multiplication.

THE COURT: I was concerned with the question as to whether or not you had here inventions for all manner of processes by which you could put divers elements together and produce yeast, but you don't do that, you grow yeast. As I understand, it grows from a certain kind of cell which when properly fed sloughs off and that bud then becomes another cell and so the process continues, buds on buds, until you get through. That is, the cells

always multiply, the yeast creating a larger quantity of yeast, is that the idea?

MR. WATSON: That is correct.

THE WITNESS: That is the gist of it.

By THE COURT:

Q. 30a. But it is the liquid nourishment which produces the thing which causes the bud to grow?

A. Yes.

Q. 30b. The original cell saturates the solution in which you placed it. That is what causes the bud to grow, is that it?

A. Yes, I think that is correct, your Honor. The original cell will not grow unless it can absorb food from the solution in which it is swimming.

Q. 30c. Now, what do you put in that solution, is it the same in all the patents? Of what is the solution made?

By MR. WATSON:

Q. 30d. All right, Doctor. Then referring to Plaintiff's Exhibit 1, the patent '103, what are the yeast nutrients employed?

A. The yeast nutrients employed in this patent are first sugary materials. To the solution of sugar materials are added a number of salts, inorganic salts, one particularly mentioned of particular interest is ammonium sulphate and other ammonium salts. I might say that the object of these salts is to furnish other food requirements to the yeast, not only must it have the carbon derived from the sugar and the oxygen which I have spoken of from the air, but it must also have some nitrogen, and ammonium salts will furnish that nitrogen. Then too yeast, like other plants, contains an ash or at least when it is burned some ashy material is left behind, proving that these inorganic materials must also be present for the proper growth

of the yeast and so this solution contains salts such as I have mentioned, and particularly these ammonium salts, for their nitrogen content.

Referring to the '103 patent you will find on the first page, the second column, at line 72, a description of a certain suitable yeast nutrient solution, which reads as follows:

"A suitable yeast-nutrient solution for the propagation of yeast according to the method of my present invention may be formed as follows and as described in my aforesaid co-pending application Serial No. 420,829; 100 parts of sugar are dissolved in tap water together with 6 parts ammonium sulfate, 2 parts ammonium dihydrogenphosphate"—the formula follows:

"4 parts potassium sulfate, 2 1/3 parts of gypsum and 2 1/3 parts magnesium sulfate and the solution is made up to a total quantity of 6500 to 7000 parts with the requisite quantity of water, (all 'parts' being stated by weight)." That is the gist of an illustrative solution.

What I have said so far about the patent I think is summarized in the short paragraph beginning line 11 of the first page. I will read those lines: "This invention relates to a process for the manufacture of yeast, particularly bakers' yeast, by propagation in a solution containing sugar material and yeast nourishing inorganic salts."

The next paragraph reads as follows:

"An object of this invention is to provide a procedure for the manufacture of yeast on a large scale commercially, there being added to the nutrient solution which contains sugar material and yeast nourishing inorganic salts a neutralizing agent for neutralizing the deleterious excess of acidity."

When seed yeast is added to a nutrient solution, such as we have spoken of, and yeast growth takes

place in such a solution, it has been found that in the presence of these ammonium salts acidity develops as a result of the consumption of a portion of this ammonium sulfate by the yeast. The yeast eats, so to speak, the ammonium part of the salt, and acidity remains in the solution, since the sulfate part of the salt is not consumed. That acidity, if it accumulates and is unrestrained, will affect harmfully the growth and life of the yeast, and it is advantageous to neutralize this deleterious acidity by means of antacid substances, things that perform this neutralizing action, for instance, alkalies or alkaline substances, and prevent in this way the acidity from increasing and from any deleterious effect arising therefrom.

As your Honor well knows, there are many ways of destroying acidity or sourness, as it is sometimes spoken of, colloquially. Substances can be added which will combine with what is responsible for that acidity and convert it into a harmless substance.

So this patent provides for the addition of a neutralizing agent to the nutrient solution, so as to destroy this harmful acidity. It suggests as one substance for this purpose calcium carbonate.

I call attention in that connection to the matter appearing beginning at page 1, column 2, line 67:

"but other basic or antacid substances such as antacid substances containing or supplying nitrogen can also be employed for the neutralization."

As to supplying nitrogen, this paragraph or sentence referred to points out that an antacid substance containing nitrogen can be employed, in which case we realize the advantage not only of a neutralizing agent, something that will destroy the acidity, but also something that will furnish this desirable item of food for the yeast, namely the nitrogen.

Referring to line 104, column 1:

"Molasses may be used in my process as a suitable source of sugar for the yeast production."

Molasses contains large quantities of sugar and is available at relatively low cost, so that it is a desirable substance to use on that account for the manufacture of yeast, as a source of sugar.

The patent in column 1, line 32 speaks of infection. In the art this means that these nutrient solutions which are prepared for rapid propagation of yeast also furnish a favorable environment in which other unwanted organisms may develop, other types of yeast which, if they propagate and increase in amount, will injure the average quality of the product; or bacteria, which may develop in the nutrient solution, may also result in an inferior product. So it is important to avoid such infection either by wild yeast, so to speak, or yeast that is like weeds, on the one hand, or by bacteria, which may set up harmful actions in the yeast itself, or in the solution.

Plaintiff's Exhibit 2, the second patent in suit, '105, has the same broad objects as the earlier patent, but one particular feature merits emphasis. When yeast grows in a nutrient solution, and multiplies, the foodstuffs are of course consumed. They are utilized in the production of the yeast. But another process takes place to which reference has already been made. In addition to its growth, yeast also ferments the sugar in its vicinity. This fermentation of sugar results in the conversion of sugar into alcohol, and a gaseous product, called carbon dioxide. The alcohol remains dissolved, at least for the most part, in the liquid; the carbon dioxide bubbles out of the liquid, and it is a familiar sight in fermenting material to see bubbles of gas being evolved from the fermenting liquid. Now, in so far as fermentation takes place, along with

growth, some of the foodstuffs, some of the sugar in particular, has been converted into an unwanted substance—it has been converted into alcohol, which in general has a lesser value than the desired yeast. So if possible it is a desired object to diminish the production of alcohol and increase the production of yeast in a given nutrient solution; that is, to have conditions which will favor growth rather than fermentation.

Now, that is one of the objects to which this patent '105 is particularly directed, and that is brought out by the title of the patent, "Low-Alcohol Yeast."

The first paragraph at the top of column 2 of the patent, page 1, reads:

"In the process described hereinafter and forming the subject of this invention, the goal of obtaining a high yeast yield with little or no formation of alcohol is reached by the use of worts of normal quality and concentration, the wort being added to the yeast continuously and at a rate such that no large excess of alcohol will be formed, and the yeast can assimilate most of the alcohol which is so formed."

That paragraph describes the operative procedure followed by the inventor to secure a less amount of fermentation, a less amount of alcohol, and an increased amount of yeast. That is, in other words, a solution, a nutrient solution, is added to a portion of this same solution containing the growing yeast, in a considerably diluted condition, and is fed in at a rate such that the yeast can consume this added foodstuff advantageously. If the yeast were left to grow in the original dilute solution, shortly the food supply would become exhausted and the yeast would cease to grow. If, however, a concentrated solution containing a considerable quantity of these foodstuffs is fed slowly into this dilute solution, and in a regulated

fashion, so that all the food that the yeast requires is made available immediately but not too much, that is, a surfeit isn't afforded but an adequate amount, growth will progress under optimum conditions. Also, it is the case that in a dilute solution, such as this, where the sugar in particular is present in relatively small amounts, fermentation does not take place in so great amount as would otherwise be the case. In other words, a dilute solution is employed in which the yeast is actually present, and but little alcohol, alcohol formation, results. At the same time the foodstuffs are fed in at a regulated rate to maintain these desirable conditions at which but little fermentation occurs and optimum growth. Moreover, if a little alcohol is formed in this process, since the yeast is not surfeited with food, it will feed on this alcohol, and this alcohol will serve as a foodstuff for the yeast, and as a consequence will not be wasted from the point of view of yeast manufacture.

Q. 39. What is the significance of the final sentence, the last full paragraph on page 1, which reads:

"The quantity of the diluted wort which is originally available for the yeast is so chosen, for example, that the mean content of the entire wort employed would be 3° to 5° Balling."

A. This is an additional direction as furnished by the inventor to insure——

Q. 40. May I interrupt you first? Will you tell us what Balling means as used in this art of yeast manufacture?

THE COURT: First I would like to know what is wort.

THE WITNESS: Wort is the expression employed for the nutrient solution prepared for the growth of the yeast.

Now, answering your question as to the meaning of the word Balling, this refers to a scale representing the specific gravity or density of the solution, and

the scale expresses the per cent. of dissolved solids present. Thus, if one says 5 degrees Balling, it means that in solutions of this type, where the dissolved solids are mostly sugar, 5 per cent. of the solution, by weight, consists of these dissolved solids. One degree Balling would be 1 per cent.

Now, continuing with the remainder of your question, in this paragraph, or in this part of the paragraph, the inventor gives additional directions to secure a desirable control of his operation. Suppose, for instance, following his general directions, a small part only of the dilute solution, seeded with the yeast, was placed in the propagating vat, and that concentrated solution was then fed in at the regulated rate as explained before. Yeast growth would take place, and as more and more of the concentrated solution was added, more and more yeast would accumulate in this propagating vat.

Now, if the proportion of dilute nutrient solution originally present, we will say is only one part in ten of the combined solutions, including the concentrated as well, since at the end of the propagating period practically all of the sugar material furnished by the concentrated solution would have been converted into yeast, we should have a great amount of yeast at a high concentration in this propagating vat.

Now, actually such a solution would crowd the yeast unduly, and it is desirable therefore to start with a greater quantity of the dilute solution originally in the vat, a very considerable quantity indeed of the dilute solution in the vat, so that when all of the concentrated solution has been added and yeast has been produced in this vat, there shall not be undue crowding of the yeast during the final stages of the operation; and the inventor states that if one is careful to so choose the amounts and concentrations of dilute

nutrient solution, the average Balling or per cent. of solids in the two solutions, dilute and concentrated together, lies within the range of 3 to 5 Balling, favorable conditions throughout the propagation will be maintained. So that here is an important additional suggestion as to the proper conduct of this propagation.

Q. 42. Now, will you explain briefly the disclosure of the '106 patent, Dr. Lamb?

The process of this '106 patent involves the same procedure of regulated addition of a concentrated solution of the foodstuffs to a dilute solution, as was described in patent '105, with the advantages attendant on that mode of feeding of the yeast. This disclosure, however, includes the use of inorganic salts, particularly ammonium sulfate, in such nutrient solutions. Of course, deleterious acidity develops here as before pointed out and neutralization is adopted as the means of remedying this situation as in '103, so that in '106 then we have the advantages of a regulated feeding program and also of the neutralization of deleterious acidity developed from the inorganic salts.

By THE COURT:

Q. 44. Now, are those the two points then covered by this '106?

A. Yes.

Q. 45. Now let us do the same thing with '105, Doctor; see if I get it from what you have said, that the gist of this patent '106 is a regulated feeding program which results in the neutralization of acidity; is that about right?

A. I shouldn't say "which" results in; I should say "and." Two features are there.

Q. 46. Two features?

A. Yes, one is a manipulative, operative feature, method of feeding, and the other has to do with the

production of a chemical change, the neutralization of this acidity.

Q. 47. But you don't have any mechanical operation as to that, that takes place naturally in the solution, does it?

A. It too must be regulated so as to do the proper amount of neutralization.

Q. 48. Now, go back to '105. How can I appraise the value of that patent along the same line? You see, here you have given me a very clear idea of regulated feeding and neutralization of acidity. Now go back to '105. What do you state again is the gist or substance of that one?

A. Well, if you wish a correspondingly brief statement, one could say that patent '105 discloses the process of regulated feeding. That is a very brief statement.

Q. 50. Then when you come to '106 you also have regulated feeding too, a program?

A. Well, the regulated feeding is a program.

Q. 51. Described in this patent, which of course I haven't read.

A. Yes. You might say regulated—if you wish to use the program phrase, I would say that the same phrase applies to both. The regulated program of feeding is covered broadly by both.

Q. 52. But one patent, to wit, '105, does it by one means and '106 by another?

A. No, sir, both use the same regulated program of feeding. '106 in addition takes advantages of neutralization to destroy any harmful acidity that might be developed when inorganic ammonium salts are employed, which are not mentioned specifically in patent '105.

Q. 53. You will pardon me if I take a little time with that: I want to get some of the basic ideas in

my mind. There is nothing in the patent '103 concerning regulated feeding, is there?

A. No, sir.

Q. 54. That simply gives a formula, line 72 to 85; is that all there is to that patent '103?

MR. WATSON: As is customarily the case, your Honor, you probably get the most terse statement of the gist of these things in claims.

THE COURT: What is the claim that corresponds to line 72 to 85?

MR. WATSON: All of them will read broadly on that example. The language of the claims is, of course, broader than any one specific example.

THE COURT: Of course, there are no formulas in the claims at all.

MR. WATSON: Oh, no.

THE COURT: It wouldn't be properly there, would it?

MR. WATSON: It would be of questionable propriety; it would be of course terribly specific.

THE COURT: It would limit you?

MR. WATSON: Yes. We are relying on all the claims of that patent except 5 and 6. I should have stated perhaps in my opening statement that we have given the defendant notice of the particular claims upon which we are relying in each of the patents and they in turn have given us notice of the particular prior art that they are relying on in defense.

DIRECT EXAMINATION BY MR. WATSON (Continued):

Q. 55. Now, will you turn, Dr. Lamb, to Plaintiff's Exhibit 4, the '109 patent, and give a similarly terse statement of its subject matter?

A. This patent, with the same broad aims as the patents previously mentioned, discloses the use of the same process of regulated feeding as in patents '105 and '106. It also discloses neutralization as does patent '106. In addition it discloses the use of a nitrogenous neutralizing agent, that is, a neutralizing agent which not only destroys acidity but also furnishes food to the growing yeast.

THE COURT: Plus nitrogenous, what was that word?

THE WITNESS: Nitrogenous neutralizing agent, which not only destroys the deleterious acidity but also furnishes this wanted nitrogen for the growth of the yeast. This nitrogenous neutralizing agent may be added in regulated amounts in the course of the propagation of the yeast.

Ammonium hydrate is a chemical substance formula NH_4OH, formerly known as ammonium hydroxide. Ammonium hydrate is a somewhat less used term now for this substance, ammonium hydroxide being the more familiar one and aqua ammonia is a solution of ammonium hydrate in water or of ammonium hydroxide in water.

On page 2 appears the sentence, beginning with line 14:

"The remainder of the nitrogenous substance required for supplying necessary yeast assimilable nitrogen for the yeast, is added in the form of free ammonia (ammonia water), to the relatively concentrated nutrient solution, which is gradually and substantially continuously added to the more dilute nutrient solution during propagation of the yeast." This describes the addition of ammonia water to the relatively concentrated solution which is then added to the more dilute solution during the propagation of the yeast.

Q. 59. Now, turn, please, to Plaintiff's Exhibit 5, patent '735, and state briefly its general disclosure.

A. This patent discloses procedure similar to that of '105 and '106, that is, a concentrated nutrient solution is added in a carefully regulated fashion to a dilute nutrient solution in which the yeast is present and in which the yeast is to be propagated. During this addition, neutralization of deleterious acidity is practiced as in '106, if necessary. However, after an interval there, some fraction of the total period of propagation, say one-half or one-third or one-fourth of the total period of propagation, the addition of the nutrient solution, the concentrated nutrient solution is interrupted, aeration——

By The Court:

Q. 60. Now, just let me get that. You say that this '735 discloses similar processes to those set forth in patents '105 and '106, plus an interval of time, then the addition of a nutrient solution——

A. Is interrupted.

Q. 62. The addition of nutrient solution is stopped?

A. Yes.

Q. 63. Then I haven't this right, I will get it this way: plus time, then stopping, of addition of nutrient solution; in other words, you are pouring a nutrient solution in; then when you get to a certain point in the age of the process of forming the yeast you stop feeding the nutrient and then go on with it again later, or don't you?

A. Yes, you go on later, after this period which perhaps would be perhaps 3, 4, 5, 6, 7 hours, as the case may be,—the supply of the nutrient liquid is cut off, as your Honor has stated; the air is turned off, and the propagation of the yeast is entirely interrupted.

Q. 64. So that interruption is really the gist of this patent, isn't it?

A. And what follows. At this point a portion of this nutrient liquid in which propagation is progressing is drawn off.

Q. 65. Now, let's see what we have to start with. We have what is termed here the solution in which the yeast is growing, it is called water. We now have the process in operation; in other words, the seed is in the water?

A. Right.

Q. 66. Now, you take some of that out, it is in solution?

A. The seed is being put in the dilute water; it has started to grow, blown air through it to favor the growth.

Q. 67. Then you stop?

A. You are feeding in the concentrated solution and you continue this for several hours, some fraction of the total period that you contemplate making the yeast, and then you stop; you turn off the air, you turn off the supply of food which you have been feeding in; you then draw out of your vat say one-half this material and feed in water in place of what you have drawn out, the object being to restore, if you can, as nearly as possible, the conditions in the solution that prevailed at the outset of the propagation. You see, yeast has been accumulating in that solution, it has been growing.

Q. 69. Yes, and crowding, as you say?

A. Yes. Now, those other products that formed in the growth have accumulated in the solution.

Q. 70. I just want to get a memorandum of that. Well, after you have added water, then what else is done?

A. Then the air is turned on again; the supply of food is also turned on, regulated feeding is again started, and the process continues. It may be——

Q. 71-2. You put back in the wort, or whatever you call it, the whole commodity? You put that back in again, do you?

A. You put in water, and then you start feeding that yeast that is left in the solution.

Q. 73. Yes. Now, what becomes of what you have taken out?

A. And what you have taken out, you can run through the separators, if you desire, and filter off the yeast that you have made, separate out the yeast that you have made, and——

Q. 74. Well, that doesn't go back in again?

A. That doesn't go back in but, if you desire, this solution that has been drawn off, this portion that has been drawn off, can be run into another vat, and its propagation can be continued again, after the addition of water. So that the initial conditions are restored. In other words, this is an interrupted process as contrasted with a straight-away process.

Q. 75. In other words, you slow it down again?

A. You try to dilute back to the original conditions, to start again.

Q. 76. Yes. And what is what you—well, of course, that is a matter of argument, I suppose it is your position that that was new?

A. Yes.

Q. 77. At the time of this patent.

DIRECT EXAMINATION BY MR. WATSON (Continued):

Q. 78. Does this patent, '735, include the feature of neutralization that you have spoken of before, Dr. Lamb?

A. Yes.

MR. WATSON: I will now state on the record, as I probably should have before, that plaintiff is relying on the following claims of the first patent, '103: Numbers 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12,

13, 14 and 15. Of these claims the following were held valid in the former litigation: Numbers 1, 2, 3, 4, 7, 8, 12, 13, 14 and 15.

Plaintiff relies upon all of the claims in the second patent in suit, and of these numbers 4, 8, 9 and 10 were held valid in the prior litigation.

When I speak of the holding of validity, there was no holding of invalidity of any of the other claims.

As to the third patent, plaintiff relies on claims 1, 3, 4, 5, 6, 8, 12, 13 and 15, of which the following have been sustained heretofore: 1, 3, 4, 5, 6, 8, 12 and 13.

As to the fifth patent, '735, plaintiff relies on claims 1, 5, 6, 10, 13, 14, 17, 18 and 21.

All of the claims of the fourth patent, '109.

I will interrupt to offer a stipulation which includes the corporate capacity of the parties and that sort of thing, the use of printed Patent Office copies and so forth. Instead of offering it as an exhibit, I think the reporter may just embody it in the record.

(The stipulation referred to follows:)

It Is Hereby Stipulated by and between counsel for the respective parties, for the purpose of this case, as follows:

1. Title to the patents in suit and corporate capacity of the parties is stipulated to be as alleged in the bill of complaint.

2. Printed Patent Office copies of United States and foreign patents may be used with the same force and effect as originals.

3. Photostatic copies of specifications and drawings of foreign letters patent on file in the United States Patent Office may be used with the

same force and effect as if certified under Revised Statute 893.

4. Certified copies of patent applications and proceedings thereon in the United States and foreign Patent Offices may be used without further authentication with the same force and effect as originals.

5. Photostatic copies of publications may be used with the same force and effect as originals, the dates of publication appearing thereon or set up in the pleadings to be taken as prima facie correct, subject to correction if error appear.

The article by Henneberg in Centralblatt f. Bakt. etc. II Abt. Bd. XX No. 8/9, pages 225-229, was published in the year 1908.

6. Of the art set up in the answer and the amendments thereto, defendant expects to offer at the trial of this cause the following as at present advised. Other art referred to at the trial will be by way of showing the prior state of the art rather than as anticipations.

UNITED STATES PATENTS.

1,201,062	Lavedan	October 10, 1916
1,475,215	Wohl	November 27, 1923
1,449,102	Hayduck	March 20, 1923

BRITISH PATENTS.

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21,011 of 1896—Jacquemin
11,617 of 1913—Molhant
174,625 of 1922—Moskovits

GERMAN PATENTS.

10,135	1879	Rainer
72,605	1893	Graeger

FRENCH PATENTS.

436,401	1911	Brog, et al.
470,925	1914	Roth

SWISS PATENT.

65,539	1913	Pollak

AUSTRIAN PATENT.

45/4047	1895	Fritsche

UNITED STATES PUBLICATIONS.

Journal of the Society of Chemical Industry Vol. XXVII, 1908, page 415-16—an article by W. Henneberg.

Journal of the Society of Chemical Industry Vol. XXVII, 1908, page 1034—an article by F. Hayduck, "Yeast Poison in Cereals."

American Distillers' Review, Vol. 4; 1914; page 132.

Pure Products Magazine (New York) 1908, pp. 224-229.

Pure Products Magazine (New York) 1911, pp. 157-159.

FOREIGN PUBLICATIONS.

Centralblatt f. Bakt. etc. 1914, page 562, an article by Widar Brenner starting on page 555, entitled "The Nitrogen Nutrition of Mold Fungi."

Presshefe Kunsthefe und Backpulver by Adolf Wilfert, published in 1890 in Vienna, pages 192-195.

Wochenschrift fur Brauerei, January 18, 1903, Vol. 20, No. 3, page 25, an article by M. Delbrück.

Centralblatt f. Bakt. etc. Part II, Vol. XXII, pages 108-114 (1909).

Chemiker Zeitung, 1908, page 595—an article by F. Hayduck.

Zeitschrift fur Spiritusindustrie, 41 Jahg. Nr. 43, October 24, 1918—an article by W. Henneberg —pages 403-404.

Handbuch der Presshefefabrikation, von Dr. Wilhelm Kiby, edited by Friedrich Viewegt Sohn, Braunschweig, in 1912 (Germany) pages 510, 511 and 606; 248.

Delbrück "Illustriertes Brennerei—Lexikon" Berlin, 1915—pages 517, 518; 39; 532 and 540.

Brennerei Zeitung, 36 (1919) 8239—an article by G. E. Ellrodt.

Die Zuckerindustrie, Vol. 40, pages 650 to 654 (1919) Vol. 40—an article by F. Hayduck.

Carungsbakteriologische Praktikum—Henneberg—Berlin, 1909, pages 643 and 644.

7. The attached translations of the documents in foreign languages included in the documents listed above under 6 have been agreed upon as far as possible in the time permitted by both parties, and may be used without further proof or authentication, except that if any errors are found therein either party is at liberty to produce a witness or witnesses to establish the correct translation.

(Signed) CLAIR V. JOHNSON,
Of Counsel for Plaintiff.
W. B. MORTON,
Of Counsel for Defendant.

AFTERNOON SESSION.

ARTHUR B. LAMB, resumed the stand.

DIRECT EXAMINATION BY MR. WATSON (Continued):

THE WITNESS: I have studied these mash sheets and flow sheets of defendant's operation, Plaintiff's Exhibit 13, which represent factory records of certain yeast propagating operations of defendants from September 12th to September 15th, 1931, and I have read as carefully as I could the answers of the defendant to the interrogatories, which included information helping to understand these sheets. I might say in further explanation of these sheets that they consist in part evidently of entries of proposed amounts of materials to be taken and of additions to be made, and so forth, and when such materials were taken and such additions were made the entries have been checked to indicate that that has been accomplished. I have also prepared some brief memoranda on these changes to which I will refer, because otherwise I am sure it would take me a long time to present the information of these sheets in a form that could be utilized.

The first mash sheet bears the heading: "Saturday, September the 12th, for Tuesday, September the 15th" and shows that a mash, part of it was made up and used for the manufacture of seed yeast and the remainder for the manufacture of commercial yeast. That will be seen from examination of the middle of this page. Just below that is given the proposed distribution of these materials for those purposes. It is, as you will see, 42 per cent. for seed, and that is put in two iron fermenters, as they are called, or propagating vats, and 58 per cent. for commercial yeast—that is put in three wooden fermenters.

The next two sheets are headed: "Seed 138, 2 G A, the first F and the same heading, second F", re-

spectively, dated September 15, 1931. These are the entries as to the varieties of seed yeast employed in this propagation. The sheets on which these entries occur tell the story for the manufacture of the seed yeast in these iron fermenters as indicated on the following page, iron fermenter 1, iron fermenter 2.

The last three sheets labeled M559, 560 and 561 respectively, are the flow sheets for the commercial yeast manufacture in three wooden fermenters or propagating vats designated at the bottom of the pages as No. 1, No. 2 and No. 4 respectively. Now, the mash materials used for the manufacture of commercial yeast—and I might explain that this term "mash materials" refers to the raw materials which were utilized for the preparation of sugar solution in which the yeast was grown—are shown on the sheet headed M559 at the upper left-hand corner. The amounts are respectively of malt 1525 pounds, sprouts 1750 pounds and molasses 9700 pounds. This makes a total, you will find, of 12,975 pounds of raw materials, raw mash materials. This corresponds to the proposed distribution of materials given on the first page where 58 per cent. of materials there indicated were taken for the manufacture of the commercial as distinguished from the seed yeast.

I might now turn to the preparation of the mashes. The molasses for use in this process was diluted with water, three parts of water to two parts of molasses. That follows a statement in the answers to interrogatories. It was treated with sulfuric acid and mono-calcium phosphate, those entries occur on the first page, by heating to boiling and allowing the treated molasses to stand overnight. These dates are evident from the times indicated on the first page. For the amount of molasses indicated, used in the commercial manufacture of yeast, sixty pounds of sulfuric acid was taken and about forty-five pounds of mono-calcium

phosphate. Of course, the weight shown on page 1 of these mash sheets namely, twenty-six liters of the acid and eighty pounds of the mono-calcium phosphate, were used for both the commercial and seed yeast. These figures have to be multiplied then by the 58 per cent. to get the figures that I have given. These figures are confirmed by the entry at the top of Flow Sheet M-559, under calcium phosphate, in the upper left-hand corner, forty-five pounds. The grain materials were ground and mashed to saccharify the starch that they contain, and were then placed in the sour tank, and souring started, presumably by the inoculation with lactic acid bacteria, on Monday morning, September 14th. That is indicated on the first page. This cereal material was then allowed to sour until 6 A. M. on Tuesday morning. The figures given at the bottom of the first page, 11 cc., 23 cc. and so forth, represent the number of cubic centimeters of a neutralizing agent required in testing for the acidity. That is, the operator in charge of these processes followed the progress of the souring of this mash by removing a fixed portion of this solution and testing it chemically by what is spoken of as the process of titration and these figures represent the acidity of the solution on the scale which they employed. I might say that, following the statements in their replies to the interrogatories, this scale involved the titration of forty cubic centimeters of the solution with one-tenth normal sodium hydroxide solution. At the right-hand side at the bottom of page 1 are shown similar figures which are apparently, judging by the time entries, similar titrations made on the molasses which had been acidified by the sulfuric acid and mono-calcium phosphate; and, if I am correct in this inference, the titration made at 6 A. M. served to check the condition of molasses and to be sure that it was not infected with

undesirable organisms which, had they been present, might have induced additional acidification or souring. Apparently, then, the molasses was not separately inoculated with the lactic acid bacteria. I find no indication on these sheets of any aqua ammonia added to the cereal material during souring. The amounts of ammonia noted on the flow sheets in several places as being used during the manufacture of seed and commercial yeast apparently indicates that none was added during the mashing operations.

The molasses mash and the cereal mash are now mixed together and heated to 170 degrees Fahrenheit shown by an entry at the bottom of the first page. This was to kill the lactic acid bacteria and the mashes were then filtered off through the draff of the cereal mash in the usual way to remove the suspended solid matter that might be present. The filtrate or the clear liquid from this process, this operation, was then led into three tanks designated as LCT, large copper tank, see mash sheet M559 and SCT, meaning small copper tank, see mash sheet for the seed yeast 138-2 GA, and a tank designated IP—we obtain those initials from the fact that it was of iron and was sometimes used as a pre-fermenter, although here it was used merely as a storage tank. The small copper tank was apparently filled up with the first run of filtrate and its contents all used as seed yeast or for the manufacture of seed yeast. The large copper tank contained further portions of filtrate and some of the water that was used to wash out nutrient liquid from the draff, so-called, that is, the undissolved solid matter from grains. This liquid is spoken of as the "sparge water." Eighty per cent. of this mixture was used for commercial yeast and 20 per cent. for seed yeast, as can be seen from entries on mash sheet 559 about the middle of the page. The IP tank was also filled up with some of the filtrate and the sparge waters; also some of the filtrate was

reserved for addition to the three wooden fermenters which were to be used for the propagation of the commercial yeast presumably, along with the residual sparge waters. The final density of the solution in the large copper tank was 11.3 Balling and of the solution in the IP tank 11.9 Balling. These entries are also to be found on the middle of mash sheet M559.

Now, about the addition of salts and inorganic nutrients, the figures at the top of mash sheet M559 at the left opposite the word "ammonium sulfate" and under the headings LCT and IP, indicate that 100 pounds of ammonium sulfate was added to the LCT tank of which 80 pounds went to the commercial yeast manufacture, and 40 pounds to the IP tank, making a total of 120 pounds of ammonium sulfate in the feed for the commercial yeast. This is indicated by the entry at the upper right-hand corner of this sheet; the figures 40 and 15 near the middle of the sheet and opposite brackets mean that 40 liters or 80 pounds of aqua ammonia was added to the large copper tank, of which 80 per cent., that is 64 pounds, went into the commercial yeast manufacture, and 15 liters, or 30 pounds, of aqua ammonia was added to the IP tank, making a total of 94 pounds of ammonia.

This checks with the figure, the first figure, following the word Ammonia in the table at the top of the page on the left.

Now, as regards the charging of the propagating vats, the fermenters, with these nutrient solutions: The reserved portion of the concentrated solution above mentioned, that is, the original solution, together with additional sparge water, was run into the wooden fermenters, and was brought in each to a dilution, by the addition of water if necessary, so that there was an initial density of 1.4 degrees Balling.

This figure can be seen at the top of the second column, at the middle of page 559, and indeed of all three of the mash sheets describing the commercial yeast manufacture. The temperature of this solution, after dilution, is shown in the second column, and the initial value on page 559 is 27.5 degrees Centigrade; 560, 28 degrees; 561, 27 degrees Centigrade. The acidity of this solution is shown in the fourth column and can be seen to be 1.5. This is on the same scale of acidity as was explained previously. To each propagating vat, to each fermenter, either before or after the adjustment of the density, I can't tell which, 75 pounds of ammonium phosphate was added. This can be seen in the fifth column under the caption A, and 20 pounds of ammonium sulphate, as shown in the next column under the caption C.

This initial solution, therefore, contained the same yeast materials as the solution in the reserve tanks, the reserve tanks LCT and IP; and by and large may be considered a diluted portion of this solution, although the exact portions of ingredients are not exactly the same.

Now, about the conduct of the propagation: Still examining Mash Sheet 559, we can see that aeration was commenced, as the entry "Air" in the seventh column opposite the time entry of half-past two. The seed yeast was added, presumably added, previously to the completion of dilution and probably just before the air was turned on. The entry as regards the air indicates that aeration was continued throughout the process of the propagation.

Now, about the addition of the concentrated nutrient solution, if one examines the right-hand column, headed Feed, we see opposite the figures 3:30, which is evidently half-past three, a numeral 1 with a circle about it. This indicates that at half-past three one cock

was opened for the admission of this feed wort, or concentrated solution, flowing from one or both of the reserve tanks, LCT and IP. The rate of flow from this one cock, or from any one cock has been given by defendant as 75 gallons per hour. So that this entry would indicate that at half-past three one cock was turned on and feed solution allowed to flow in at the rate of 75 gallons an hour. After two hours, under these conditions, an additional cock was opened, and two hours later a third; six and one-half hours later the entry of feed was finished by turning off one of those three cocks so that only two remained open. This feed was continued until five o'clock, which is labeled on the mash sheet 559 as the finish, when all the supply was turned off.

Counting up the intervals of time and the number of cocks opened one can say then that all told there were 31½ cock hours of feed supplied, and multiplying this by 75 gallons gives a total of 2362 gallons of feed supplied in this regulated fashion during the propagation.

I call attention again to the fact that there were used a progressive increase in the rate of supply of this feed, followed by a diminution thereof, about in accordance with the growth requirements of the yeast. We also see that this regulated supply of feed has maintained a fairly constant density of the solution, drops a little at first and then rises steadily toward the end, but not numerically to any great height. The density of this solution is affected not only by the dissolved materials but also by the yeast that is floating about in it as well. As I have indicated, the Balling was read at successive hourly intervals throughout the propagation, temperature also read, and the acidity as shown in column 4 was also determined by this process of titration which I have explained before.

Now, if we examine the sixth column of these mash sheets and flow sheets, the column headed C, which represents additions of ammonium sulfate, we see that in addition to the 20 pounds ammonium sulfate added at the start that there are notations for the addition of ammonium sulfate at further intervals. Thus there is one for the addition of ammonium sulfate at half-past five, half-past seven, half-past nine, half-past eleven, half-past one, half-past three, at two-hourly intervals. Closer inspection, however, shows that only the first three of those additions have been checked off; the remainder have been crossed out, which indicates that the program laid out has not been adhered to. The proposed additions of ammonium sulfate at the ninth hour, that is, 11.30, 1.30 and 3.30, were not made. I would call your attention to the acidity figures over these intervals starting at 1.5 at the outset; there is a rise followed by a drop and then a further rise shown on mash sheet 559, and at 11.30 the acidity has risen to 3.1. Opposite this acidity and opposite the first entry of ammonium sulfate, which is crossed out, we see the figure 12 under capital B, which proves to be 12 liters or probably 12 pounds—it isn't 12 liters but 12 pounds, of aqua ammonia. In other words, at this time, when the operator had contemplated the addition of more ammonium sulfate he crossed out the ammonium sulfate entry and instead of adding it added 12 pounds of a neutralizing agent, aqua ammonia, with the result that a diminution in the acidity occurred such that even an hour afterwards it still had not reached its acidity of 3.1. An hour later the acidity had mounted to 3.5. Here again the operator's program showed the addition of 14 pounds of ammonium sulfate. This is crossed out and in its place 12 pounds more of aqua ammonia was added, with a consequent drop in

the acidity by neutralization. We find this repeated again at three-thirty, the thirteenth hour. Here, however, the end of the propagation period is approaching and the operator chose only to add ten pounds of ammonia to produce some neutralization. The eleventh hour it still had risen to about 3.0. These additions of ammonia do not, however, represent all the ammonia utilized in the propagation of this yeast. As I have pointed out, aqua ammonia added to large copper tank and also to the IP tank, containing reserve solution which was subsequently fed into the propagating vat. This ammonia with the acid formed during souring, largely lactic acid, formed ammonium lactate and this then was also introduced into the fermenter, where released inorganic acid existed and it too acted as a neutralizing agent.

Looking particularly now to mash sheet 560, I can say that here the general procedure is evidently the same as in the case of the operations I have described in detail in connection with mash sheet 559, except that the change in the intended additions of ammonium sulfate was made in a somewhat different way. Here, as before, it was proposed to add 14 pounds of ammonium sulfate at two-hourly intervals throughout the propagation, 11 pounds at four-thirty, but here at the seventh hour there was no undue rise in the acidity and the third addition of ammonium sulfate was made as proposed.

However, at twelve-thirty, the ninth hour, the acidity figure rose to 3.4, and here we have the 14 pounds crossed out and in its place we find the addition of 12 pounds of aqua ammonia. The same thing happened at half-past two; the acidity rose to 3.5 and the operator added 12 pounds of aqua ammonia. Two hours later, when his program called for the addition——

THE COURT: Did it rise to 3.5 then?

THE WITNESS: Yes. This is on Mash Sheet 560.

THE COURT: Oh, yes.

THE WITNESS: At the eleventh hour.

THE COURT: Yes.

A. (Continuing.) It rose to 3.5, and he added the ammonia; but at four-thirty, that is at the thirteenth hour, when the program called for the addition of 11 pounds of ammonium sulfate, the acidity had not risen. It was only 2.8. And we find the operator goes on with the addition of the proposed ammonium sulfate without the addition of any aqua ammonia. Here again, then, in this we find that the operator achieves neutralization down to the desired acidity and the desired hydrogen ion level.

Turning to Flow Sheet 561, again the general procedure is very similar. We find, however, that the unwanted rise in acidity occurred at the seventh hour; that is, at eleven-thirty; and the addition of aqua ammonia is shown and the omission of the addition of the ammonium sulfate. This substitution of a neutralizing agent for the ammonium sulfate was in this instance made at four intervals: At eleven-thirty, at one-thirty, at three-thirty and at five-thirty. So here again aqua ammonia was added to overcome the deleterious acidity, but the amounts as can be seen are diminished as the tendency in this direction decreased toward the end.

Now, there is only one other notation that I have with regard to this set of mash sheets. That has to do with the mean concentration which was employed or which obtained. The mean concentration or the mean content of all the worts can be obtained by multiplying together the volumes of the separate solu-

tions employed by their per cent. content of dissolved solids, that is by their Balling, adding these figures together, and dividing by the total volume. That will give the mean or average content of the worts employed. I have applied this method of computation to this instance of yeast manufacture. Thus, 5000 gallons of 11.3 Balling and 2000 gallons of 11.9 Balling were fed into the three fermenters. Those figures were obtained from answers to the interrogatories. They are the volumes of feed solution furnished from the large copper tank and from IP. The total volume of the nutrient solution originally present in all three fermenters was 28,000 gallons, and this, as I pointed out, has a Balling of 1.4. The sum of the products of Balling and volume of all these liquids is 56,500 plus 23,800, plus 39,200, or 119,500 units. Dividing this product by the total volume, that is 35,000 gallons, we obtain the mean content or mean Balling for the entire wort of 3.4 degrees. This, then, is the mean Balling of the entire worts.

That completes all the notations I have made on this set of pages.

As to Plaintiff's Exhibit 14 which comprise further records of defendant's commercial operations, the first page of these mash sheets bears the heading, "Mash to be made Saturday, 4/25/31, for Monday, 4/27/31" and indicates that the two iron fermenters, M177 and 178, and two wooden fermenters M179 and 180, are to be used, and that all of the mash was to be utilized in the manufacture of commercial yeast. There is no statement about any manufacture of any seed yeast in these sheets. That makes this discussion somewhat simpler than in the other case. The materials and their preparation can first be discussed. The first page states that 13,350 pounds of molasses, 2000 or 2300 pounds of sprouts,—the little rootlets that form in the

malting operations, the barley grain and other similar grains, and when the malt is dry these sprouts easily fall off and are a separate portion from the malt itself —and 2100 pounds of malt were used. The molasses was treated as in the previously described manufacture, 16 liters, 64 pounds of sulphuric acid, and 65 pounds of calcium phosphate being added. The cereal materials were saccharified as before and soured. In this case, however, the souring was prolonged and otherwise modified. Specifically, the grain was soured for all of the first day and was titrated from time to time as shown in the lower left-hand corner of this first page; after each titration there is a notation that ammonia was added, aqua ammonia. For example, at 10 o'clock when the acidity in the soured mash was 12 cc., under the heading "Test," 10 liters of aqua ammonia was added. The other tests of acidity were taken at the times indicated and the number of liters of ammonia added are given in the third column; a total of 64 liters or 128 pounds was added during this first day's souring. The souring was continued overnight and on the morning of the second day the molasses was added and the souring still continued. At 3 P. M., shown at the right table, the acidity of the combined mash was 32 cc. and 16 liters of ammonia was added. Additional titrations, tests, were made at 10 P. M., 1 A. M., and 6:30 P. M., the total amounts of ammonia added during this second day of souring was 43 liters or 86 pounds, making a total of 214 pounds of aqua ammonia added during the souring. I point out, as I have in connection with previous discussion, that the ammonia that was added during this souring process formed chiefly ammonium lactate, lactic acid being the principal acid formed in this souring process. This ammonium lactate subsequently acted as a neutralizing agent for the deleterious acidity created in the fermenters during the propagat-

ing period. The addition of this ammonia also permitted the lactic acid bacteria to convert more sugar into lactic acid and thus enable the operator to build up a larger amount of this neutralizing agent in the reserve solution than was the case in the mash that I have previously discussed.

I would point out the processes of the flow sheets M-177 to 180 show the effect of this treatment of these solutions. No aqua ammonia was added directly to the propagating vats as was the case in the previously discussed flow sheets. Evidently the operator did not find it necessary because of the large amount of ammonia added to the mash during the souring operation.

Now, about the filtration of the mash, addition of salts and inorganic nutrients. Here again the mixed cereal and malts mash, after heating to 165 degrees Fahrenheit, in order to kill the lactic acid bacteria, was filtered from the draff and run into the tanks SCT, LCT and IP, though apparently none was used for seed yeast manufacture.

And as shown at the top of Flow Sheet 177, 50 pounds of ammonium sulfate was added to SCT, 100 pounds to LCT, 40 pounds to IP. This total of 190 pounds plus the amounts of ammonium sulfate added to the fermenters in the beginning, as shown by the Figure 30 at the head of the sixth column under C, and occasionally during the propagating period as shown by the Figure 7 at the end of the ninth hour, giving a total of 162 pounds, added to the four fermenters, totaling out to the 352 pounds shown opposite the words "ammonium sulfate" at the upper left-hand corner of M-177; also as can be seen from near the middle of this flow sheet, M-177, the density of the solution in the SCT tank was 13.6, in LCT 12.00, and in IP 12.9, after the sparge waters had been put in; and as shown by the figures checked at the right-hand side of the brackets, 20 liters or 40 pounds of aqua ammonia was added

to the SCT tank, 40 liters or 80 pounds of ammonia to the LCT tank, and 15 liters or 30 pounds to IP. That aqua ammonia, as I have explained before, also formed ammonium lactate in the reserve solution, which also acted as a nitrogenous neutralizing agent for the deleterious acidity in the fermenter during the propagation.

I think I was mistaken in what I said there. I think that 12.00 is the time. I should have said 14.3 was the Balling of the solution in the LCT tank.

Now, referring to Mash Sheet 177, it is to be seen that portions of the original solution and additional sparge water were run into the propagating vats to a density of one degree Balling, at a temperature of twenty-eight and a half degrees and an acidity of 1.5, 85 pounds of ammonium phosphate, 30 pounds of ammonium sulfate and 400 pounds of seed yeast were added to this solution, either before or after the adjustment of the density. Aeration was now begun and continued throughout the propagation period. Continuous feed was started at one o'clock, as shown in the right-hand column, with a single cock open, at three o'clock two cocks—an additional cock, making two cocks were opened, at 7:30 still another, making three, at 10:30 still another, making four; at 12:30 a total of five were opened. Here again if one computes the number of cock hours, converting this into gallons, we find that some 2662 gallons of reserve solution were fed to the propagating vat during the period of propagation.

The initial acidity of the solution shows on mash sheet 177 as 1.5. It rises steadily until a maximum of 4.9 is reached at 9 o'clock, apparently without any direct addition of aqua ammonia being made to the propagating vat or fermenter. It will be recalled in the propagation described on flow sheet M559 the initial acidity was also 1.5 and when it had risen to about 3.1 aqua ammonia was added. This difference in procedure corresponds with the fact that these figures for

acidity are for titratable acidity and they do not have precisely the same significance in worts, that is, in nutrient solutions of different composition. The acidity that affects the growth of yeast is what chemists speak of as hydrogen ion concentration, and this is by no means identical with titratable acidity. You will find, as a matter of fact, that these manufacturers frequently make direct determinations of the hydrogen ion concentration along with determining this titratable acidity that we have spoken of before. As soon as an operator is familiar with any given type of mash he can tell from his figures of titratable acidity whether his nutrient solution is becoming too acid.

Now, the procedure shown on mash sheets Nos. 177, 178, 179 and 180, do not differ particularly from the procedure above described in connection with M177, except that the total cock hours of M178 was 35 hours and M179 and 180, 31½ hours, as compared with 35½ hours which was found in M177. I don't know the reason for this difference but it may have been a different amount of solution initially present in the fermenter or perhaps because of the fact that there is a difference in amount of reserve solution.

Q. 83. I ask you, Dr. Lamb, if there is any significance on that point from the Figure 400 on sheets 177 and 178 as the amount of seed yeast that you start with and the Figures 375 and 375 on the latter two sheets?

A. Yes, I should think there was reasonable correspondence. In those two propagations where 35 and 35½ cock hours of feed were fed in, there were 400 pounds of seed yeast in the fermenter. In those cases, where only 31½ cock hours were employed, there was only 375 pounds of seed yeast in each fermenter, indicating presumably a slight difference in capacity of these separate vats, certainly in the amounts of material run into them.

Now, I only have a remaining notation here with regard to the mean concentration of the worts. I have followed the same method I employed before, that is, I have multiplied the volume of the respective worts by its Balling, taken the sum of these products and divided this sum by the total volume, and the result is the mean content of the Balling. The volume of the dilute solution was 37,000 gallons, 1 degree Balling. The product, therefore, is 37,000. The volume of feed was 5000 gallons at 14.3 Balling, giving a product of 71,500; 2000 gallons at 12.9 gives a product of 25,800 and 2500 gallons at 13.6 Balling gives a product of 34,000. The sum of these products is 168,300 units, divided by a total volume which was 46,500 gallons, gives us the mean content of the combined wort, 3.6 Balling.

Referring to Plaintiff's Exhibit 15, which shows the defendant's factory records of operations in December, 1932, the first page of these sheets shows the mash materials and the mashing operations from Wednesday, December 7th to Friday, December 9. It appears from the attached flow sheets under the date mark, that is this for the year 1932. As shown at the upper left-hand part of Sheet 1, the principal mash materials used were malt, 3600 pounds, sprouts, 3900 pounds, and molasses 23,000. I interpret the two figures that I haven't mentioned, with (1) and (2) after them, as indicating two separate portions of sprouts which taken together would correspond to 3900 total. Some of these materials was used for the manufacture of the seed yeast and the remainder for commercial yeast, as I think will appear later. Here again the molasses was treated with sulfuric acid and calcium phosphate, heated to boiling, and allowed to stand overnight, as the previously described mashes. The mashed grain materials were run to the sour tubs, inoculated with the lactic acid bacterium, and soured for twenty-four

hours. That fact is obtained from the defendant's answers to interrogatories. During which time, as shown on the left-and side of the mash sheet, at the bottom, a total of 102 liters of B, that is aqua ammonia, was added. This corresponds to 204 pounds. According to the answers to interrogatories, the next morning the treated molasses was decanted into the solid grain mash, and souring was continued for twenty hours, during which time, as shown at the right-hand side of this mash sheet a total of 76 liters, or 152 pounds of additional aqua ammonia was added. This made a total of 356 pounds of aqua ammonia added during the souring treatment. This corresponds, this arithmetic, to the statement in the interrogatories that a total of 350 to 400 pounds of ammonia was added during the two days of souring. The combined soured mash was then heated to 170 degrees Fahrenheit, filtered as previously described, and 1/5 to 1/6 of the filtrate, that we get from the interrogatories, was used for seed yeast manufacture, and a part of the remainder used for making up the dilute nutrient solution in the fermenters. The residue was pumped into a wooden storage tank, referred to at the right upper corner of Mash Sheet 3539, and was diluted with wash waters, that is, with sparge waters, up to 16,500 gallons, that figure also occurs on Mash Sheet 3539, with the addition of 60 liters or 120 pounds of aqua ammonia and 257 pounds of ammonium sulphate.

This 120 pounds of aqua ammonia plus the 4/5 of the 356 pounds previously added to the soured combined mashes to form ammonium lactate, makes a total of 405 pounds. Of course, this ammonium lactate here represents a nitrogenous neutralizing agent. This flow sheet 3539 shows that the gravity of this reserve solution was 11.9 and its acidity was 3.0. You see in the upper right-hand corner of this page the acidity figure

4.0. The reserve portion of the filtrate from mash which I mentioned before, which was designed for preparing the nutrient solution in the fermenters was evidently divided equally between the four wooden fermenters or propagating vats designated as wood No. 4 on flow sheet 3539, wood No. 1 on flow sheet 3540, wood No. 2 on flow sheet 3542 and wood No. 3 on flow sheet 3543, and sparge waters were added to bring the volume of each fermenter up to 9600 gallons. That figure was also obtained from the answer to interrogatories. Also as shown on the first line of a process table from flow sheet 3539 opposite the hour 12:30, 50 pounds of A, that is ammonium phosfate, 20 pounds of C ammonium sulfate, and the seed yeast were added to the dilute nutrient solution in the fermenter, which then had a density of 1.30 Balling. Aeration is commenced as in the previously described processes and at the end of the first hour, that is, at 1:30, as seen in the right-hand column, mash sheet 3539, three cocks are opened to permit the reserve solution to flow into the propagating vat. Two hours later, at 3:30, another cock was opened; two hours later, at 5:30, still another cock was opened, making a total at that time of five cocks opened. And this situation continued until 7:45 when the process of addition was stopped. Totaling up this addition of reserve solution, we find that 25¼ cock hours were added in this interval. Also as previously the acidity and Balling determinations were made at each hour and ammonium sulfate was added from time to time as will be seen, for instance, at 4 o'clock, half-past five and 7 o'clock, there are entries of 9, 9 and 9 pounds under the heading C. However, in this process an additional material has been added as compared with the other flow sheets as shown in the column headed D. This material is di-ammonium phosfate. Twenty pounds of it was added between 12:30 and 2 o'clock. The exact time cannot be ascer-

tained, probably at 1:30; 15 pounds was added between 2 and 3 o'clock, another 15 pounds at 4 o'clock, 8 pounds at half-past five. I would like to point out that this material, di-ammonium phosfate, containing twice as much ammonium as mono-ammonium phosfate, is not only a source of nitrogenous food for the yeast but is also a neutralizing agent overcoming deleterious acidity from utilization of the inorganic ammonium salts.

I should also like to point out, in view of what I have said a little while ago about hydrogen ions, that the operator has made some additional determinations, shown in the column headed pH, fifth column in this sheet, and has given figures which represent another measure of acidity, but in this case a more significant measure of acidity, in that it represents the actual concentration of the hydrogen ion, a thing that is really responsible for the acidity. One can also see another novelty in this process table as contrasted with the other tables that we have so far considered. The addition of the nutrient solution was discontinued at 7:45, that is after seven hours and fifteen minutes, which is approximately one-half of the total period of propagation. The notations on the process table, for instance those at the middle of the sheet, state that also at 6:15 the coolers were stopped. Those are the pipes through which cold water runs and are utilized to control the temperature of the nutrient solution, and water is added at this time. At 7:45, an hour and a half afterwards, when the addition of reserve solution had been terminated, shown on the right-hand column, the operator began to back one-half of the nutrient solutions in this wooden fermenter into Iron Fermenter No. 2; that is, he proceeded to pump out half of the content of that vat into another vat. The answer to the interrogatories shows that sufficient water was added at this time to bring the total volume in this vat up to 13,000 gallons, at the time the division was made; and by sub-

tracting the sum of 9600 gallons, initially in the fermenter, plus the volume of reserved solution added, namely, 1894 gallons, from 13,000, I find that 1500 gallons of water must have been used for this purpose. The solution that was pumped into Iron Fermenter No. 2, had a density of 1.30 according to Mash Sheet 3541, and this must correspond very closely to the density of the solution in the wooden fermenter before it was divided, or at the time of the division, which shows that the addition of water was made until the density had dropped back substantially to the initial density of the original solution, which was 1.30.

Now, Flow Sheet 3540 discloses or describes a similar procedure in Wooden Fermenter No. 1, where practically everything that I have said before applies. The half of the diluted solution that was withdrawn from Wooden Fermenter No. 1 was also backed up into this same Iron Fermenter No. 2. After this division of the propagating liquid into wooden fermenters, propagation was resumed in the diluted residual solution left behind, whose volume was 6500 gallons, approximately half the volume of the diluted solution before part of it was withdrawn. Aeration was resumed, the concentrated reserve wort was fed in in amounts and at times shown in the right-hand column. Thus at 8 o'clock two cocks were opened, in fifteen minutes more two additional cocks were opened, making a total of four. This was continued for three hours, to 11:15, when one cock was turned off, leaving three cocks running, and this rate of addition was continued until 11:45, when addition was stopped. Propagation was continued until 1:15 to ripen off the yeast, and then, as can be seen from the notations at the bottom of the sheet, the solution was run to the separators and separation carried on from 1:15 to 1:55.

I would also point out that during this second stage of propagation an addition of ammonium sulfate

was made, as can be seen from the entry of 10 pounds in column headed C on Sheet 3539. Similarly, additions of di-ammonium phosphate were made at intervals during this second period of propagation, namely 8 pounds at 9:30 and 6 pounds at 11:30, shown in column headed D.

A similar procedure was followed in respect to all four of these solutions in the wooden fermenters. The diluted portions from Wood Fermenter No. 2 were backed up or pumped up into Iron Fermenter No. 1. As follows from my previous statements, each of these nine fermenters at the beginning then of its treatment contained twice as much propagating liquid and yeast as did the residual portions in each of the wooden fermenters; that is, there were 13,000 gallons of wort dilute solution in each of the iron fermenters while there were only 6500 gallons nutrient solution or wort in each of the wooden fermenters in the second period of propagation. Additions of ammonium sulfate and di-ammonium phosfate were made to these iron fermenters. The process tables are respectively 3541 and 3544, as shown in the columns C and D, and it is worthy of note that the amount of di-ammonium phosfate added to each of the iron fermenters was approximately twice that added to the wood fermenters during the same period. It is also noteworthy that the additions of the reserve wort were also approximately double, as can be seen from the circled numerals in the right-hand columns on these sheets and as can be seen perhaps still better from the number of cock hours, namely, 31 and 32 cock hours, which were fed in respectively to Iron Fermenters 2 and 1 as compared with the 14 hours each of reserve solution fed into the wooden fermenters. This clearly shows a proportioning of the addition of nutrient solution in accordance with the growth requirements of the yeast.

Now, I have only further to discuss on these sheets the question of mean concentration. I don't think it is perhaps necessary to go through the details of this calculation again. I follow the same method as before, that is, I have multiplied the volume of each nutrient solution employed by its corresponding Balling. I have added these products together and have divided by the total volume of all the solutions, of course taking into account the 4 times 1500 or 6000 gallons of water that was added to the four wooden fermenters, making 6000 gallons of water used for dilution. The result I obtained is 4.0 for the mean content of Balling of the worts taken as a whole.

Newark, N. J., October 16, 1935.

Trial resumed pursuant to adjournment.

Mr. W. B. Morton and Mr. H. Stanley Mansfield, representing the firm of Pennie, Davis, Marvin & Edmonds, with the consent of the Court and other counsel, have withdrawn from the case. Paul R. Ames, Esq., of Messrs. Fish, Richardson & Neave, entered an appearance as of counsel for defendant. Other appearances as before noted.

JOHN W. LUCE, called and sworn for the plaintiff, testified as follows:

DIRECT EXAMINATION BY MR. JOHNSON:

THE WITNESS: I reside at Larchmont, New York, 22 Bonnie Briar Lane. I am production manager of Standard Brands. I have been with Standard Brands Incorporated and its predecessor, the Fleischmann Company, since 1915. I was located in Chicago from 1915 to 1919, working in one of our yeast plants there.

From 1919 to 1929 I was at the Peekskill plant as superintendent, and from 1929 to the present date I have been production manager. As superintendent I was familiar with the way in which yeast was wrapped for bakers by the company, since 1923.

This wax wrapper I can identify as bearing the same notice that we have had since around June, 1923. It is not exactly the same wrapper but the notice is the same. The wrapper differs in size and the rest of the text is a little different. They have the six points on there. "Why 30,000 bakers prefer Fleischmann's yeast." That was not on the other wrappers. The only notation on the other wrappers was as to the patent. The patent notice reads "Fleischmann's yeast, patented and manufactured under processes protected by U. S. patents issued March 20, 1923." That has been on our bakers' yeast packages since 1923 continuously.

MR. JOHNSON: I offer the wrapper just identified by the witness as Plaintiff's Exhibit 16.

(Received and marked Exhibit P-16.)

THE WITNESS: In my work with the Fleischmann Company I am in general familiar with the processes used since I came with the company in 1915 and generally theretofore by the company.

The first named process used by the company in the manufacture of bakers' yeast was the old process, "O. P." That process was carried out using the mash materials which were entirely cereal, consisting of corn, rye and malt. These were ground up and cooked, saccharified, and the entire grain materials and everything else were pumped into the fermenter and stocked with seed yeast, which took about forty-eight hours. Then this yeast was skimmed off from the fermentation, screened to get rid of the hulls and washed and pressed. The yeast rose to the top and was mixed with the hulls

of the grain and was run over a silk screen, silk bolting cloth, so as to get rid of the hulls. That process may have been patented at one time, but at that time it was free to the use of anyone. We continued that down to 1911, along in there.

DIRECT EXAMINATION BY MR. JOHNSON (Continued):

THE WITNESS: The yield varied all the way from at the start 1½ pounds of yeast to a bushel of grain up to between 6½ to 7 pounds at the end. We made very slight improvements as time went on. We thought it was quite an improvement when we went from 1½ to 3 pounds, for instance; then again when we went from 3 pounds to 6 pounds. The commercial average yield of that process was between 6 and 7 pounds. That would be 12 per cent. So that 1½ pounds would be only between 3 and 4 per cent. Some slight aeration was used and about 7 gallons of alcohol per hundred pounds was obtained as a by-product.

The next process used by the company was called "N. P.," new process. This was made from corn malt, corn, rye, and barley malt.

As to how this process differed, as far as mashing and fermentation was concerned, from the O. P. Mash, in this process the mashing was in general very similar to the O. P. mashing, but in this process you separated the wort from the grains, and you had a clear wort in your fermenter, rather than the bulk of the grains. This was then run over separators and pressed. Aeration was used in that process.

The yield of yeast per hundred pounds of grain was 28 per cent. We obtained two and a half gallons of alcohol per hundred pounds. That was continued to 1913, I should say.

The next process used was called G. B., German Bakers. The mash bill in this case was the same as on the preceding one, with the exception that we elim-

inated corn malt. Here the grains were mashed up in a very similar manner, and the extract filtered off, and put in the fermenter; aeration was used, the yeast was grown and separated. It gave a yield of about 35 per cent.; about two and one-half gallons of alcohol.

THE COURT: Now, what year did the new process commence?

THE WITNESS: The new process commenced in 1911, and the G. B. commenced in 1913.

THE COURT: What do you mean by the G. B.?

THE WITNESS: German Bakers.

MR. JOHNSON: That is the last process.

THE WITNESS: This is the one which——

THE COURT: The process described in the patents we are concerned with here started in 1923, did it?

THE WITNESS: That is when the patent was issued, in 1923.

MR. JOHNSON: If your Honor please, I am going to take the witness right up through the present processes.

THE COURT: Yes.

Q. 30. Now, how long did the N. P. Process continue in use?

A. From 1911 to 1913.

Q. 31. How long did the G. B. Process continue?

A. From 1913 to 1917.

Q. 31a. What was the next process used?

A. G. B. M. This was the same as the G. B. with the exception that the corn was eliminated and molasses substituted for it. The average yeast yield on this process was 33 per cent.

THE COURT: Per cent. of what?

THE WITNESS: Per hundred pounds of material.

Q. 33. And did you obtain any alcohol?

A. Two gallons per hundred pounds of material.

Q. 35. And how long was this process continued?

A. Until 1919, when we started to make the A. M. mash.

Q. 36. Can you tell me whether or not at any time between the A. M. process and the G. B. M. process the G. B. process was reverted to?

A. It might have been directly after the war. Yes, I think it was, for a while.

Q. 37. Now, the Court has asked you about the O. P. process, whether or not it was patented and was free to the use by the public. Can you answer the same question as to these processes that you have heretofore described, if you know?

A. I really don't know. I think that those were all free to anyone; they must be, they are so old.

THE COURT: When did molasses first come in, 1917?

THE WITNESS: In this particular type of mash, yes, but molasses has been used in other types of fermentations much earlier than that, where they make low yields and poor quality yeast.

MR. JOHNSON: I believe your Honor was asking as to the operations of the plaintiff company, were you not?

THE COURT: Yes.

Q. 38. When was molasses first used by the Fleischmann Company?

A. This was around 1919 that we first used molasses in this type of process—I beg your pardon, we first used it in 1917 in the G. B. M.

Q. 39. And you have spoken of an A. M. process which came into use in 1919. Will you please describe that process generally?

A. This was an all-molasses process in which the molasses was put into the fermenter, that is, all the molasses was added to the fermenter at the start and ammonium phosfate added and also additional aqua ammonia which acted as a neutralizing agent as well as to supply nitrogen. The term in the industry for that kind of a process is "straight set" fermentation. The yield of yeast in that process was up to sixty-five pounds per hundred pounds. No alcohol was obtained. Aeration was used in the process. The process took twenty to twenty-four hours.

The next process used by the company was the C. B.

Q. 46. And how was that carried out?

A. C. B. stands for cane and beet.

Q. 47. Cane and beet what?

A. Molasses—no, we had another process before the C. B. after the A. M.

Q. 48. What was that?

A. That was D. M. This was an all-molasses mash and in this one we used the Zulauf process together with neutralization and addition of salts.

Q. 49. Will you please describe in your words briefly what the Zulauf process is?

A. In the Zulauf process only a part of the nutrient medium was added to the fermenter at the start. This is diluted with a rather large amount of water and the seed yeast is added and your ammonium salts. You start aerating and add varying amounts of the remainder of the reserve wort till the fermentation is finished, and during the course of the fermentation you add, either continuously or from time to time, varying amounts of aqua ammonia and ammo-

nium salts so as to provide the yeast with the necessary amount of nitrogen, at the same time to neutralize any deleterious acidity which may arise.

Q. 50. Now, you have referred to the addition of varying amounts of aqua ammonia and its purpose; you also referred to the addition of varying amounts of reserve solution. Will you please describe that "varying."

A. The reserved solution is added so as to provide the yeast with the proper amount of nourishment, depending upon the particular amount of yeast which is in the fermenter at that time. The ammonia is added for two purposes, one to provide nitrogen and also to neutralize any deleterious acidity. You have a rather flexible—you have a great deal of flexibility in your addition of ammonia or ammonium salts, depending on whether you want to provide only for neutralization or whether you want to provide for neutralization plus addition of nitrogen. We are still using the Zulauf process. The average yield of yeast per one hundred pounds of main mash materials is 80 per cent., and no alcohol.

By The Court:

Q. 53. In material do you include the water content?

A. No, sir. I beg your pardon, there is some water content in molasses.

Q. 54. Well, of course. But you don't include the water you put in—you do put some water in?

A. Yes, we have a large amount of water.

Q. 55. So when you say you get eighty pounds to every 100 pounds you mean the more or less solid material?

A. We mean we get eighty pounds from every 100 pounds of materials we use, using molasses, ammonia and everything else.

Q. 56. You assume twenty pounds of waste, is that of any value, is that used at all?

A. Well, there is no other by-product recovered. It goes away in the form of different by-products of the fermentation. It is very difficult, your Honor, to say that there is twenty pounds waste because a pound of yeast and materials are not two synonymous terms; in other words, if we use 100 pounds of materials we only get eighty pounds of yeast from it. It is not the same as it would be if we mix up starch and sugar together and we are accustomed to getting 100 pounds from that. We make a complete transformation of the various food materials in the molasses and the others into an entirely different form, and there is always a loss in any transformation of that kind. We say we eat 100 pounds of meat but we don't grow 100 pounds.

DIRECT EXAMINATION BY MR. JOHNSON (Continued):

Q. 56a. Do you know whether the Fleischmann Company used at any time the Zulauf process, using cereal materials as the mash ingredients?

A. Yes, we have.

Q. 57. I believe you did not mention that. Do you know how long that continued?

A. That was around the same time, 1923. We used the two processes, in fact, almost contemporaneously, the molasses and the grain. I would say—maybe for two years after that, after 1923.

Q. 58. Can you tell us in round numbers the amount of bakers' yeast manufactured and sold by the Fleischmann Company and Standard Brands Incorporated using molasses, ammonium salts and neutralization? From the A. M. process, in other words, up to date?

A. Oh, a little over two billion pounds.

Q. 59. And can you give me an approximate percentage of that which was manufactured by the Zulauf process as distinguished from the A. M. process?

A. About 1,700,000,000 on the Zulauf process.

Q. 60. Can you describe briefly the advantages from a manufacturing standpoint of using molasses and ammonium salts for your nutrients as compared with the cereal materials?

A. Without regard for cost of materials, there is also a big advantage from a manufacturing standpoint. You don't have the expensive mashing and heating equipment. The whole preparation of the mash up to the time that you are actually making yeast is very simple and only goes through one operation in comparison to several operations on grain. It takes much less steam, much less labor. In fact, it is an ideal material to use in comparison purely from a manufacturing standpoint.

Q. 61. And can you tell us in general the ratio of cereal materials to molasses, as far as the cost is concerned, over the past twenty-five years?

A. In general, grain has always cost more than molasses. There may have been a few times when the cost of molasses as used for yeast would be more expensive than grain, but the normal relationship is just the opposite. We use all kinds of molasses.

Briefly the advantages of the Zulauf process over the A. M. process that I have described are that the Zulauf process, in the first place, gives you an increase from 65 per cent. to 80 per cent. in your yield. It gives you a much greater increase in plant capacity, because you can make more yeast with the same equipment, and it also gives you a better quality of yeast.

Q. 64. I show you Plaintiff's Exhibits 13, 14 and 15, which are mash sheets and flow sheets showing defendant's operations that have been introduced in this

record, and ask you whether from your experience you can tell by looking at the hours of fermentation, the density, per cent. Balling figures, and the feed column—by the way, I might tell you that the figures in the circles at the right-hand side under the Yield column represent the number of cocks open at the periods indicated at seventy-five gallons per hour for each cock. Can you tell me from your experience, looking at these mash sheets, whether any alcohol would be contained in the beer from which the yeast is separated at the end of the process?

A. No, there would be no alcohol.

MR. JOHNSON: That is all.

CROSS-EXAMINATION BY MR. PHILBIN:

XQ. 65. Referring to Plaintiff's Exhibit 16, which appears to be a wrapper, containing the statement, "Patented and manufactured under processes protected by U. S. Patents issued March 20, 1923," when were such wrappers first put out?

A. Around June 1, 1923.

I can't tell you the exact day. I have recently looked up the records in my company to ascertain what date it was and my recollection is that such records show it was about June 1st.

Seven plants were putting out this kind of yeast at that time in the United States and the wrappers for all those plants were made at the same place, in Cincinnati, Ohio, and then they were distributed to these various plants.

XQ. 73. Do you know when they were made in Cincinnati?

A. Why they must have been made some time previous to June—they were made some time between March 5 and June 1; and the reason, I assume, that they did not all go out on exactly the same date was because of the varying amounts of the old style wrappers which

they had on hand; that is, they used up the old style wrappers economically and then used this type of wrapper.

XQ. 75. And you think that took one or two months?

A. I know that they went in around the 1st of June. That is the reason we cannot give you a definite date.

This report refers to U. S. patents issued March 20, 1923. I do not know how many patents owned by the Fleischmann Company were issued on that date or how many Hayduck patents were issued on that date.

XQ. 79. Do you know whether or not there was a Hayduck Patent No. 1,449,102?

A. I really couldn't tell any of these patent numbers, sir; I just know the last figures, '103, 4, 5 and 6, like that, but I don't know——

MR. JOHNSON: Your Honor please, this witness was produced merely as a fact witness to show when that patent mark was put on. He has no more idea what is in the patents than your Honor had two weeks ago.

MR. PHILBIN: I have not asked him what was in the patents, your Honor; I have merely asked him if he knows what patents were referred to.

THE COURT: Apparently he doesn't.

THE WITNESS: That "old process" which I spoke of, and which contained only cereals, corn, rye and malt, which cereals were ground up, we stopped using in 1911. The process of grinding is simply running the whole grains over an ordinary roller mill and breaking them up in small pieces. The corn is then put into a high pressure cooker, heated up with steam and the starch partially gelatinized; the rye is added and cooled down to saccharification temperature and malt is added and it is held there a little while, till the

starch is saccharified; then you pump the whole thing into a fermenter. Part of the mash is soured by using lactic acid bacteria culture which was a common process at that time.

I gave some figures for the yield of yeast and of alcohol from that process based on the pounds of grain used. It would be possible to give that percentage on the basis of the sugar content. To convert it into terms of sugar content approximately I would have to sit down and figure it out because each grain has a slightly different starch content and your conversion factor is a little different for each one. I haven't those figures right here; it would take a few minutes to do that.

We got some yeast and got some alcohol from this "Old Process." We sold the yeast and also the alcohol. As to which we got the most for, I really couldn't give you anything on selling prices because I have nothing at hand connected with the sales end of our business. I am production manager now but at that time I was not connected with the company.

In the second process, so called, the "New Process," we got both yeast and alcohol.

As to the prices of those two commodities, I really don't know anything about any of our selling prices. I do not mean to convey the impression that the alcohol was a by-product and was of less value than the yeast produced. That would depend entirely on market conditions. The alcohol might have been a more valuable product than the yeast or vice versa, as far as my testimony is concerned.

The third process was the German Baker or G. B. process and there again we obtained some yeast and some alcohol. Whether the yeast was more valuable than the alcohol would also depend on the prices they received for their yeast. We obtained more yeast and less alcohol on that. I am not prepared to say which

was the more valuable. As I say, I have no way of telling what we received for these products.

In the old process and the new process and this G. B. process where the grains and cereals were treated, they were also soured, that is, the souring was continued in the later so-called grain processes.

In 1919 we commenced using molasses. The reason is very obvious. We had a mash which gave us much higher yields, easier to operate, cheaper.

XQ. 102. I must have my figures wrong because according to your German Bakers process from 1913 to 1917 where there was no molasses you got a 35 per cent yield of yeast and 2½ gallons of alcohol and in your next process, the G. B. M. where you used molasses you got less yeast and less alcohol, namely, 33 per cent. of yeast and 2 gallons of alcohol. Is that correct?

MR. JOHNSON: I think your figures are correct, but the year is wrong, Mr. Philbin. You asked about 1919.

THE WITNESS: Yes, you asked me originally about 1919 in the all-molasses mash. You asked me what the advantages of that were. Well, in 1919 we first commenced using molasses entirely. That was the A. M. In 1917 we used the G. B. M. process. The yield in yeast was around 33 per cent. Alcohol was around 2 gallons, 2½; it varied a little. The preceding process, the one before the G. B. M., was the G. B. There was no molasses there. The yield was 35 per cent. and the alcohol about 2½ gallons.

XQ. 114. Then I go back to what I said before, that when you used only grain in your G. B. process you got 35 per cent. yield in yeast and 2½ gallons of alcohol; when you used the grains and the molasses you got less yeast and less alcohol; isn't that correct?

A. That is the way it worked out at that time.

XQ. 115. Then why did you commence using molasses when it gave you less yeast and less alcohol?

A. Why, at that time I think it was difficult to get grain and corn.

XQ. 116. That is, it was a question of relative prices and ability to get the kind of——

A. Not entirely, no.

XQ. 117. Well, what other reason was there, when you got a poorer yield both of yeast and alcohol when you used molasses?

A. Well, there was a more or less scarcity of grain at that time due to the war. As a practical matter in 1917, when we used grains and molasses both, it became desirable to use molasses even though we got less yield in yeast and alcohol. That is, we sacrificed yield because there was more difficulty in getting the grain we wanted.

The next process was when we used all molasses and also used ammonium phosfate and aqua ammonia for the purpose of neutralizing.

XQ. 122. And also furnishing some ammonia or nitrogen with the yeast. Do you know whether these mashes, these worts in which the yeast food was contained, was acid or alkaline?

A. It was acid. That is true of all of them.

THE COURT: Just a moment. I want to be advised on a point. As I understand it, the wort, or wert, whichever is the proper pronunciation, is synonymous with the nutrient upon which the yeast feeds; is that correct?

MR. PHILBIN: Yes, your Honor.

THE COURT: Now, repeat the question the gentleman asked a moment ago.

XQ. 122 was repeated by the reporter as follows: "Do you know whether these mashes, these worts in

which the yeast food was contained, was acid or alkaline?"

THE COURT: You see, what I don't understand there is very apparent. "These worts in which the yeast food is contained."

MR. PHILBIN: Well, the wort is the water containing the yeast foods in solution; that is, the grains or the sugar or the salts are all put into a large tub of water, and that is referred to as the wort or the nutrient solution.

THE COURT: Now, repeat that question again.

(XQ. 122 was reread by the reporter.)

THE COURT: "Yeast food is contained."

MR. PHILBIN: The solution.

THE COURT: Well, that would be the wort?

MR. PHILBIN: Yes, your Honor.

THE COURT: Does it feed upon itself?

MR. PHILBIN: No, the yeast is in——

THE COURT: Repeat that question again.

(The reporter again reread XQ. 122.)

THE COURT: All right.

MR. PHILBIN: As I understand it, the way that this yeast which Dr. Lamb said might be considered of a vegetable nature is made to grow and reproduce, by budding out like a plant, is by putting some yeast, seed yeast, often termed, into a solution.

THE COURT: Now, that is called a nutrient solution, and you have also referred to it here during the progress of the trial as the wort.

MR. PHILBIN: And also, your Honor, as a mash.

THE COURT: And also as a mash. As I understood, the question you asked a moment ago would indicate that the wort, the nutrient, or the mash feeds on itself. Now, I look upon that wort or mash or nutrient as similar to the soil in which one would plant a seed.

MR. PHILBIN: Precisely.

THE COURT: Now, the soil does not feed upon itself.

MR. PHILBIN: Yes, your Honor.

THE COURT: It has certain life-giving qualities which the plant by virtue of its set-up is able to assimilate.

MR. PHILBIN: Precisely.

THE COURT: Now, then, that question that you asked would seem to indicate that the soil fed upon itself.

MR. PHILBIN: I didn't make myself clear. My question was, Is this soil of an alkaline nature or is it of an acid nature.

THE COURT: It is the question preceding that that I don't understand.

MR. JOHNSON: If your Honor please, I believe you overlooked the wort in which the yeast food. Mr. Philbin means the food for the yeast, is contained.

THE COURT: Well, it is a small matter. Proceed.

XQ. 125. As I understand it, the yeast is in a solution, and also in the solution are foods for the yeast and the yeast takes those foods and eats them and grows. Now, this solution is of a watery nature, and it might be either of an acid character or of an alkaline

character, and I asked you whether this solution was in these mashes, or processes, rather, that you have referred to, acid or alkaline, and you said acid.

A. Correct. It is desirable to have the soil or the solution acid because yeast grows better in a slightly acid medium. It also inhibits the growth of other organisms, other bacteria, and makes a favorable medium for the growth of yeast. If it is too acid that is not desirable. There are certain limits of acidity. Those limits were recognized in all these processes I have discussed. That is, the fact that there were some limits and that a slight acidity is desirable.

XQ. 133. Considering now the all-molasses process, you said that there was used molasses and ammonium phosfate and also from time to time aqua ammonia or other ammonium materials and you gave a yield of 65 per cent. of yeast. Was that a maximum yield or was it the ordinary commercial average?

A. The yield varied between 60 and 65 per cent.

XQ. 134. Can you tell us what that yield would be, based upon the sugar food in the yeast, that is, the amount of sugar that went into making the yeast?

A. Well, roughly speaking, the molasses has 50 per cent. sugar, so that the yield would be about 130 per cent.—120 to 130.

THE WITNESS: The prior process used both grain and molasses. I really couldn't give you the yield on the sugar content because I would again have to figure out the amount of sugar in the malt and sprouts, have to figure that all back to sugar. That takes a few minutes to do.

MR. JOHNSON: I believe we can supply you that later if you want it in round figures.

MR. PHILBIN: Yes, I would like it in round figures. I would also like the preceding mash so that

we will have the all-grain, the grain and molasses and the all-molasses mash on the basis of sugar.

THE WITNESS: I testified in my direct examination that we used molasses in 1917, that it had been used much earlier. I mean by the Fleischmann Company. That we had made small amounts of yeast with molasses for many years, but the yields were very low and the yeast was a poor quality.

We used aqua ammonia in the all-molasses process and the Zulauf process.

XQ. 140. Did you use anything else to take its place, or did you use only aqua ammonia?

A. We used ammonium sulfate and ammonium phosfate. Speaking strictly of the all-molasses mash and also the Zulauf mash or process as applied to the molasses, the salts most commonly used were ammonium phosfate and ammonium sulfate, aqua ammonia—that is not a salt—and calcium phosfate we used. We never used any ammonium lactate in a strictly all-molasses mash. We used di-ammonium phosphate which has more ammonia in than mono-ammonium phosphate. It has a greater neutralizing effect due to the ammonia. It also gives you more nitrogen.

XQ. 150. How long did you continue using an all-molasses mash? That is, without any grains or cereals?

A. Well, we have used all-molasses almost continuously from 1919, 1920, up until the present time. We have from time to time, at one plant or another, used all grain in the meantime, with the Zulauf process. The large majority of our product is made with molasses and containing no grains or cereals.

MR. PHILBIN: That is all.

RE-DIRECT EXAMINATION BY MR. JOHNSON:

RDQ. 153. Mr. Luce, in a process where alcohol is formed as compared to a process in which yeast is formed without alcohol yield, can you tell me whether

or not the alcohol formed in the first process is at the expense of the yeast yield?

A. Yes.

RDQ. 154. And can you tell me whether or not during all of these years of the Fleischmann Company's business it has striven to use the best processes with any given mash materials that it knows how?

A. Yes.

ARTHUR B. LAMB resumed the stand.

DIRECT EXAMINATION BY MR. WATSON (Continued):

THE WITNESS: Referring to Plaintiff's Exhibits 13, 14 and 15, the sugar material was derived chiefly from molasses, but a portion of it in each instance, a smaller portion, was derived from cereal sources, malt and malt sprouts. In all three instances inorganic ammonium salts were employed. These salts were of the sort that when they were assimilated in part by the yeast, acidity was set free in the nutrient solution. In these operations there were added substances acting to neutralize that acidity I have mentioned. Thus, in the operations described in Mash Sheets 559 and 561 aqua ammonia was added at intervals during the period of propagation to neutralize such acidity. Also in this same operation or these same operations, ammonia had been added to the reserve solution and had neutralized therein lactic acid, similar acids, and the resulting ammonium lactate was fed into the propagating vat along with the concentrated solution, and it acted as a neutralizing agent in these solutions.

The operations that I have just referred to are identified by Mash Sheets 559, etc., are for September the 12 to 15, 1931.

In defendant's operations as described in Mash Sheets 178, etc., for Saturday, April 25, and the Mash

Sheets 3539, etc., for December 7 to 9, 1932, repeated additions of aqua ammonia were made to the nutrient solution in the course of its preparation as it soured. These repeated additions of ammonia formed considerable quantities of ammonium lactate in the nutrient solution and when this substance was fed into the propagating vat in the course of these operations it functioned as a neutralizing agent for the acidity there developed. In addition I might point out that in the last mentioned operations for December 7 to 9, 1932, some di-ammonium phosfate was added at intervals to the propagating vats during the growth of the yeast and this substance too exerted some neutralizing action.

In these operations as shown by the Plaintiff's Exhibits 13 to 15, the propagation of the yeast was commenced in a relatively dilute nutrient solution and during the period of the propagation a relatively concentrated nutrient solution was fed in and in this way a regulated supply of yeast nutrients was afforded to meet the food requirements of the growing yeast.

As to Plaintiff's Exhibits 13, 14 and 15 respectively, the mean or average Ballings for the worts employed taken as a whole, I computed the solutions employed in each of these operations and I found that they were—I am giving this from memory—but I found that they were respectively 3.4, 3.6, 4.0, computed from the entire worts.

Referring to Plaintiff's Exhibit 15, after approximately one-half the total propagation period had elapsed, water was added to the dilute solution in the propagating vat, and the feed of concentrated nutrients was interrupted. In this way, the density of the solution in the propagating vat was brought back to substantially the density which it had at the outset of the process. Thereafter the supply of concentrated feed

was again started and the propagation of the yeast continued. And, by the way, I would like to point out, if I may, in this connection that I made perhaps what seems to me a mistake when I testified day before yesterday about this process. I think it is at the bottom of page 90 of the testimony. I state at the very last two lines that aeration was resumed. Now, as a matter of fact, I find no real basis for that in the exhibit. I can only say it was continued, or resumed. So that my statement, while maybe it was correct, I find no factual basis for it in the exhibit.

CROSS-EXAMINATION BY MR. PHILBIN:

THE WITNESS: Hayduck 1,449,103, page 1, line 15 and following, states:

> "An object of this invention is to provide a procedure for the manufacture of yeast on a large scale commercially, there being added to the nutrient solution which contains sugar material and yeast nourishing inorganic salts a neutralizing agent for neutralizing the deleterious excess of acidity."

That is a fair statement of what I consider to be the gist of the patent.

The patent refers to acidity and antacid substances, and salts. I shall endeavor to tell you what is meant by acidity, alkalinity, basic materials, antacid materials, salts and neutralization.

As to the word "acidity." First I would give a homely definition of it by saying that it means in a qualitative general sense the sourness of the material. Expressed somewhat more definitely and in the language of the chemist, it would refer, depending on circumstances, to the amount of acidity present in unit volume based on some standard scale of acidity. For

instance, it could represent the number of cubic centimeters of a tenth normal solution of a base required to neutralize forty cubic centimeters of the solution concerned. That, I believe, is the scale of acidities employed in the National Grain mash sheets. Somewhat different scales have been employed by other yeast manufacturing companies. Again, acidity can be expressed, and frequently in a more significant fashion, by a statement as to the concentration of the hydrogen ion, as it is called, in the solution under consideration. The hydrogen ion is recognized as the factor responsible for acidity in an aqueous solution and it is produced from many substances that we speak of as acids and in general the stronger the acid the greater percentage amount of hydrogen ion that it can produce when added in given amount to a solution. Acidity then may be defined as the concentration of hydrogen ion in the solution, and this may be represented on many scales. One scale that is often used is the so-called pH scale, which represents the concentration of the hydrogen ion on a logarithmic scale. I can go into the definition of that more fully if you would like to have me.

It is a bit too much simplified to state that a salt is neutral, an acid is on one side and a base is on the other side.

The salt, some salts, may be 100 per cent. neutral, some salts may be a little on the alkaline side and some salts may be a little bit on the basic side.

It is true that some salts when dissolved in water give a solution which is nearly neutral; others give a solution which will be faintly and sometimes strongly acid; others give solutions which are sometimes faintly alkaline and sometimes strongly alkaline. There is a great variation in that respect.

There are acidities which range from very strong acids to comparatively weak acids and the bases may be

weak, that is, close to the neutral salts, or they may be very strong bases, but as to salts, we don't ascribe any acidity or basicity to the salt as such; it is merely that salts undergo a conversion into the free acid or as the case may be the free base in water, with a consequent change in the hydrogen ion concentration. Some salts when they are dissolved in water, do exhibit, do communicate to the solution, an acid or a basic property. There are certain salts that are spoken of as basic salts in the solid state, where you have a base that is divalent, for instance calcium hydroxide, which can have only part of its basic properties neutralized, and it will be still a base and a salt. It will then be, as the expression is, a basic salt; and there are comparable acid salts. An acid and a base can be combined to form a salt.

In my testimony I meant by titrable acidity, acidity expressed on one of the scales to which I have just referred; that is to say, the amount of acid present expressed by the amount of base that is required to neutralize it, in cubic centimeters of some standard solution. Acidity is a broader term and can cover titrable acidity, and acidity that is expressed on other scales, and the two scales are by no means identical.

Turning again to this '103 patent, Haydück gives an example of the way this neutralization should be employed, stating various materials, commencing on page 1, line 72 and following, together with proportions. That is not the only specific example given in this patent of a way of employing this neutralization. This instance to which you have called my attention is an explanation of how much calcium carbonate should be added to provide for the neutralization of the acidity released from a given quantity of ammonium sulfate, and specifically the statement is that for 10 parts of ammonium sulfate, 7½ parts by weight of calcium carbonate, one particular neutralizing agent

that can be employed, is required. Now, this amount of calcium carbonate is stoichimetrically or chemically the amount that is required for the neutralization of all of this acidity. However, the patentee, in the succeeding sentences, points out that under other conditions less of this neutralizing agent may be employed, dependent on the presence of other neutralizing agents.

Referring to the description, page 1, line 71 to line 85 the source of that sugar is just sugar. It can be of any convenient origin. It is almost self-evident that the patentee would have in mind only fermentable sugars, that is sugars that could be used and assimilated by the yeast. I think somewhere in the patent there is a phrase to bring that out, that the nutrient solution does contain nutrients suitable for the propagation of the yeast.

As to what the sugar contributes to the yeast, the conventional expression is that it furnishes carbon. That leaves unstated just whether or not it takes in the carbon as such, which it almost certainly does not but rather takes it in combined with other elements. So that presumably the sugar furnishes carbon, oxygen and hydrogen, perhaps in amounts not so different from their relative proportions in sugar itself, to the yeast. So that it is an over-simplification to say that the sugar furnishes solely carbon to the yeast. It furnishes certainly those other two elements as well.

If it wasn't for the sugar the yeast would not get enough carbon unless you are interpreting sugar in a narrow sense, but broadly speaking, as I understand sugar in this patent, that is true.

XQ. 110. Now, Hayduck proposes the use of some sugar and then some ammonium sulfate. Does the ammonium furnish nitrogen directly or indirectly to the yeast?

A. Yes, it does.

The yeast as it grows and reproduces, takes up relatively little of that sulfate material; it does take up some, because we find that the ash of yeast does contain some sulfate, not much.

Next Hayduck suggests the use of another salt, that is, ammonium sulfate. It is made up of sulfuric acid as an acid and a basic material ammonia. Now, there is ammonium di-hydrogen phosfate which Hayduck proposes the use of. That is a salt. Actually it is a so-called acid salt. The ammonium is available and under favorable conditions is used by the yeast as a source of nitrogen.

XQ. 116. What about the di-hydrogen phosfate, does some of that go to nourish the yeast directly or indirectly?

A. Yes, some of it does. There again how much depends on the circumstances; sometimes a considerable amount of it may be used, indeed perhaps all of it may be used because phosfates are required for the growth of the yeast just as is nitrogen.

Potassium sulfate is another salt. The yeast uses the potassium also.

XQ. 120. Do you know of any commercial manufacture of yeast in which the yeast is propagated and grown when using sugar, fermentable sugar, as the only source of sugar material, that is, sugar as distinguished from the sugar which may be from molasses and grains? I am referring to the identity of the sugar and not its purity.

THE COURT: Sugar other than sugar from molasses, is that it?

MR. PHILBIN: Yes, your Honor.

A. Yes, it is my understanding that other sources of sugar are used; I cannot specify but——

XQ. 123. I am sorry I did not make myself clear. I asked you whether you knew whether sugar itself was

used in any commercial manufacture of yeast in the propagating vat.

A. Of course, sugar is present in molasses, ordinary sugar is exactly the same as the sugar—or I won't say exactly the same because there are so many different kinds of molasses, but so-called sucrose, to use the chemical term for sugar, pure sucrose is the same sugar that occurs in many molasses as the chief ingredient.

XQ. 124. Excluding the sugar from molasses and grains, do you know of any commercial manufacturing using ordinary sugar?

A. You mean excluding sucrose?

XQ. 125. I mean excluding the sugar you get from molasses and grain.

A. Well, I don't know of any commercial manufacture of yeast from those other sources of sugar; they might be used; maybe such manufactures that I am not familiar with.

XQ. 126. Now, in this Hayduck example of his neutralization process he uses a certain amount of sugar, 100 parts, and he uses a certain amount of nitrogen-supplying material. Can you tell us approximately what is the ratio of the amount of sugar used to the amount of nitrogen used?

A. Well, I don't carry those figures in my head. They can, of course, be calculated without great difficulty from this illustrated example that is given here. This would serve at least for this particular example as an indication of the ratio between the nitrogen supplied and the weight of sugar also supplied.

I will make that calculation, namely, how many parts of nitrogen as shown by this specific formula is available per 100 parts of sugar.

Hayduck proposes the use of calcium carbonate, a salt, as one illustrative example of a neutralizing agent.

It is a little difficult to ascertain whether it is a neutral salt, or an acid salt, or an alkaline or basic salt, because calcium carbonate or lime is practically insoluble in water, and the acidity or alkalinity that could be set up would be negligibly small in any case. I don't know what the pH value of saturated calcium carbonate is in pure water. I suspect that it is very slightly, as we say, on the alkaline side. I suspect that it might be pH8, or possibly nine. pH7 is taken as substantial neutrality. Anything with a higher pH is alkaline, that is pH8 or 9, and anything less is acid.

It is rather a loose way of putting it to say that this calcium carbonate which Hayduck proposes as a neutralizer combines with the sulfuric acid in the Hayduck wort. I shouldn't want to put it quite that way myself. I should say what happens is that the carbonate ion set free in minute amount from the calcium carbonate combines with the hydrogen ion present in the solution to form the slightly dissociated carbonic acid, and in this way diminishes the acidity of the solution. Well, it may be that you get some carbonic acid from this chemical reaction, and also calcium sulfate, a salt, that is as it may be; it all depends on what happens subsequently to the solution. You can't say whether you have calcium sulfate in the solution or not. Of course, if those are the only substances present, that is true, you would have calcium sulfate in solution. If sulfuric acid and calcium carbonate were the only substances concerned, you would have a dilute solution of calcium sulfate formed, and a corresponding amount of carbonic acid. The neutralization, in other words, is brought about by the combination of the carbonate ion with the hydrogen ion, which is in this way removed from solution, and the acidity of the solution destroyed. It is true of a solution containing nothing but those two ingredients that the sulfuric acid disappears to the extent that the calcium carbonate enables the production of calcium sulfate.

As to the solution that Hayduck proposes on page 1, lines 72 to 85, there are other substances present than sulfate ions; there are phosfate ions, there are the ions of other organic acids that may be present or formed in fermentation, and one cannot say whether it is calcium sulfate or some other one of these materials that is formed.

Calcium sulfate is not an insoluble salt in the degree that calcium carbonate is.

XQ. 140. Will you turn now in this patent to page 1, line 104, and follow me, which states: "Molasses may be used in my process as a suitable source of sugar for the yeast production and if molasses naturally containing antacid substances is used as the sugar-containing raw material the quantity of calcium carbonate employed can be reduced materially, as the antacid substances present in such molasses neutralize a part of the free acid." What is meant by antacid?

A. Antacid signifies a substance which so to speak is hostile to acids and opposes them, that overcomes them, that neutralizes them in the broadest sense, I should say. Antacid is broader that saying, alkaline or basic. It includes alkaline and basic.

XQ. 143. Referring to this part of the patent, Hayduck there states that if you use molasses you don't have to use so much calcium carbonate. Why is that?

A. There are substances present in the molasses which the patentee speaks of as antacid substances, which on their part are ready and willing to combine with hydrogen ions and eliminate them from the solution.

XQ. 144. The patent on page 2, line 50, and following, refers to a prior practice in yeast manufacture, reading as follows: "It is known that there can be added to mashes in lactic fermentation, nitrogen-supplying antacid substances, as for instance ammonia, ammonium carbonate or ammonium carbamate, for

the partial neutralization of the lactic acid progressively formed and for the augmentation of the yeast-assimilable nitrogen content of the mashes so that they may be utilized for subsequent yeast propagation." What is meant by lactic fermentation?

A. By lactic fermentation is meant presumably the process of souring to which various mashes are sometimes subjected in preparation for their use in the propagation of yeast. In this souring process lactic acid is formed in considerable amounts and this acid gives the name to this process of fermentation.

XQ. 145. When in this lactic fermentation there is supplied ammonia, as Hayduck says was known before him, is ammonium lactate formed by the combination of the ammonia with the lactic acid?

A. Yes. The addition of this ammonia in this yeast-making process neutralizes the acidity of the lactic acid.

XQ. 147. Is it undesirable in this lactic fermentation to have too much lactic acid?

THE COURT: That answers itself.

MR. PHILBIN: It seems so, yes; that is true. It is undesirable to have too much lactic acid in this lactic fermentation.

THE COURT: When you assume too much you are answering the question.

XQ. 148. And when there is too much lactic acid and there is added this ammonia, which is an antacid substance, as Hayduck says, there is a neutralization of that acidity, is there not, to an extent?

A. If there is more lactic acid added than is desired, the additional ammonia, of course, converts a portion of that lactic acid into ammonium lactate and removes that amount of lactic acid as such from the solution. If there is any deleterious excess of acidity

in this lactic fermentation, it was old to neutralize that effect by adding ammonia, according to that statement.

XQ. 150. Refer now to the second patent in suit, Hayduck, 1,449,105, for the so-called regulated feeding or Zulauf. Page 1, lines 54 to 64 state:

> "In the process described hereinafter and forming the subject of this invention, the goal of obtaining a high yeast yield with little or no formation of alcohol is reached by the use of worts of normal quality and concentration, the wort being added to the yeast continuously and at a rate such that no large excess of alcohol will be formed, and the yeast can assimilate most of the alcohol which is so formed."

Do you consider that a fair statement of the gist of this patent?

A. Well, I rather hesitate to say that is a complete statement of the patent. I think it brings out certain advantages that the patentee sees in his discovery, but I hesitate to say that it contains the whole of the invention.

XQ. 151. Well, can you express to us in simple language what you consider to be the substance of this patent?

A. Well, I tried to do that in my direct testimony. It took me some time, as you may remember, and I shall have to retrace those steps. It is all in the record. That was almost the question that was asked me. I can do it.

XQ. 152. I am not asking you to remember, verbatim, Doctor, the exact words that you used before. I am merely asking you to state in simple language what you consider to be the substance of this so-called regulated feeding patent.

THE COURT: Let's see, which one is that now?

MR. PHILBIN: '105.

THE COURT: '105. Well, I made a brief note at the time. I gather from the testimony that the gist of it is that this patent discloses a regulated feeding.

MR. PHILBIN: Yes, that is my understanding of the gist of it, with perhaps the additional elements of feeding it so that no large excess of alcohol will be formed and the yeast can eat up such alcohol as may be formed.

THE WITNESS: That hardly satisfies me as a complete statement of the——

XQ. 153. Will you add to it, Doctor?

A. It seems to me that this patent does disclose regulated feeding, that is, supplying nutriment at the optimum rate at which the yeast can consume it, but it does disclose an operative method by which this can be achieved, which is the feeding in of a concentrated, relatively concentrated solution into a relatively dilute solution, and furthermore that in selecting the volumes of their dilute solution and their concentrated solution on the one hand and their concentrations on the other, the inventor, the operator, must keep within certain bounds to secure a suitable result.

XQ. 154. Then, as I understand it, you wish to add certain features, so that a complete statement would be that the patent discloses regulated feeding, starting with a dilute wort, and then feeding in more concentrated wort, and at a rate such that not much alcohol is formed, and what there is formed is consumed by the yeast?

A. And that the operating conditions to prevent overcrowding at the end shall be secured or maintained.

XQ. 155. Where do you find that last in the patent?

A. I find that—the specific direction is lines 90 to 95.

XQ. 156. Those read, do they not, as follows:

"The quantity of the diluted wort which is originally available for the yeast is so chosen, for example, that the mean content of the entire wort employed would be 3 degrees to 5 degrees Balling." Is that right?

A. That is the specific direction, yes.

XQ. 157. And that is the specific direction and teaching to avoid overcrowding?

A. Yes.

XQ. 158. Well, will you explain that——

THE COURT: Just a moment, just a moment. Is that the same as the provision against overcrowding in '735 patent?

THE WITNESS: No, it is not.

XQ. 159. The language that you referred to, Doctor, does not mean anything to me as far as overcrowding is concerned. Will you explain why it means that to you?

A. Well, I think that I have gone into that in my earlier testimony, but the situation is this, that if one is solely told that a concentrated wort shall be fed into a dilute wort in a regulated fashion, and if one is also told, as they are in this patent, the advantages of this use of the concentrated solution, so far as economy of production is concerned, that is the advantage of using small propagating vats, one would naturally undertake to utilize this regulated feeding in a maximum degree. That is to say, one would start with a very little nutrient solution in the propagating vat, perhaps only 10 per cent. of the content of the vat. If then the concentrated solution were fed in, one could follow the teachings of the patent entirely well, feeding it in as

required; but as propagation progressed and the amount of yeast that was formed increased, a great deal of yeast would be formed in a limited space, and this condition would not be favorable to yeast growth. The patentee, therefore, specifically points out, as I have told you, in these sentences, these lines, the proportions which are to be followed, and if they are followed, this overcrowding which I have explained, does not occur.

XQ. 160. That is, you consider that this Hayduck Patent 1,449,105, discloses when intelligently read by one familiar with this art, the avoiding of undesirable overcrowding by means of starting with a dilute solution and feeding in a more concentrated solution so that more economical and efficient use can be made of a fermenter?

A. That is true.

XQ. 161. This patent on page 1, line 23, and following states: "Efforts have been made to produce economical conditions under which not only an increase of the yeast yield from the raw material used would be insured, but a simultaneous diminution of the alcohol yield would be obtained. It has therefore already been suggested to dilute the wort to such an extent that the alcohol produced from the sugar could supposedly again be assimilated by the yeast as nourishment. The process disclosed in the German patent to Rainer, 10135, endeavors to reach this goal by adding the nutrient required for the yeast (sugar and peptone), in a manner which would produce this result, i. e., by adding the peptones continuously and the sugar at intervals, as required, and whenever analysis showed the need thereof, stating that in keeping the concentration of the sugar very low the formation of alcohol is prevented and the sugar is used only as a nutrient." What are peptones, are they sources of nitrogen?

A. Yes, they contain nitrogen, carbon and oxygen and hydrogen as their chief elements, and can be utilized broadly speaking by yeasts for nitrogenous food.

XQ. 162. The quoted part states that if you keep the concentration of sugar very low you will not get much alcohol. Why is that? That is, what is the relation between a large amount of sugar and the formation of alcohol?

A. Well, I shouldn't undertake to give a very theoretical explanation of that fact because undoubtedly it is based on quite complicated physiological phenomena; but there seems to be no doubt that yeast growth and yeast fermentation of sugar are two separate processes and that the conditions that favor the one do not necessarily favor the other, and as pointed out here the dilute solution of sugar permits yeast growth but does not favor the production of alcohol.

XQ. 163. The Hayduck patent says that you should feed the yeast by adding this nutrient solution at such a rate that you do not produce much alcohol and the earlier process of Rainer as stated in the Hayduck patent also says that you feed a part of the yeast nourishment, namely, the peptones or nitrogenous material continuously and another part the sugar at intervals. Where is there in this Hayduck patent any teaching as to what this rate should be, so that you will not get much alcohol? Is that rate continuously or is it intermittently and what proportion should there be? Where do you find anything on that point? Or is it just merely a statement of a result you would like to get by feeding?

A. I find no statement in the specifications as to the details of the regulation. The production, however of alcohol, which is to be avoided in this propagation, is naturally subject to convenient test from time to time. So that it was obvious that this requirement could be controlled and followed without difficulty.

XQ. 164. Well, does that answer mean, Doctor, that Hayduck says to those skilled in the art you feed your yeast so as not to get much alcohol, and does not tell them how to do it, because the people in the art knew how to accomplish that result, once they had been told the idea was not to get much alcohol?

A. I am not prepared to agree with your summary of the situation, because the procedure of the Rainer patent as outlined, had long been recognized to be inoperative, people had been unable to secure useful results from this procedure, and instead of teaching the art the advantages of this procedure it would have led the prospective operator away from this Hayduck discovery.

XQ. 165. Doctor, Rainer, that you say was inoperative, says feed the wort so as not to get much alcohol. Hayduck says, feed the wort "at a rate such that no large excess of alcohol will be formed," exactly what Rainer said he would like to do. Is there anything in this Hayduck patent which tells you what that particular rate should be?

A. Nothing other than what I have told you and what would be known to the skilled operator.

XQ. 166. How would this skilled operator, if you know, tell, during the feeding process, whether there was alcohol being formed or not, so that he could vary his process accordingly?

A. He could examine the wort, fermenting wort, and he would also know from the favorable yields that he secured at the end, that the alcohol had been consumed, if formed.

XQ. 167. Turn now to the next Hayduck patent in suit, the 1,449,109, which discloses both neutralization and this regulated feeding. Is this '109 patent based on the same subject-matter as the Hayduck '103 so-called neutralization patent and the Hayduck '106 so-called regulated feeding patent?

A. I don't know that I understand what you mean by based on the same subject-matter.

XQ. 169. Doctor, you testified on direct that this '106 patent (p. 42) process "involves the same procedure of regulated addition of a concentrated solution of the foodstuffs to a dilute solution, as was described in Patent '105, with the advantages attendant on that mode of feeding of the yeast. This disclosure, however, includes the use of inorganic salts, particularly ammonium sulfate, in such nutrient solutions. Of course, deleterious acidity develops here as before pointed out and neutralization is adopted as the means of remedying this situation as in '103, so that in '106 then we have the advantages of a regulated feeding program and also of the neutralization of deleterious acidity developed from the inorganic salts.

"By The Court:

"Q. 44. Now, are those the two points then covered by this '106? A. Yes."

That is a fair statement, is it not, of the substance of '106 patent?

A. I think that states the high points of it.

XQ. 170. Turn now to the next Hayduck patent in suit, 1,449,109. That patent also relates to neutralization, does it not?

A. Yes.

XQ. 171. In the first Hayduck patent, '103, the specific neutralizing agent suggested by Hayduck was calcium carbonate, and in '109 patent it is (p. 2, line 54) "preferably a substance such as ammonia or ammonia water." That is correct.

A. I think that your statement about '103 was slightly inaccurate. Calcium constituted one of the specific neutralizing agents mentioned; another one mentioned in '103 is ammonium carbonate, and by in-

ference a variety of others and moreover these were cited merely as examples.

XQ. 172. In '103 patent it is said there may be used as the neutralizing agent calcium carbonate and also ammonium carbonate or similar substances. Is there any other specific substance mentioned except calcium carbonate and ammonium carbonate?

A. Not directly, but as I suggested in my answer he speaks of a number of other nitrogen-supplying antacid substances, this being the very phrase used in connection with ammonium carbonate on page 1, lines 64 to 71. I was careful to say by inference. That statement is: "For such neutralization of the acid components, calcium carbonate may suitably be employed, but other basic or antacid substances such as antacid substances containing or supplying nitrogen can also be employed for the neutralization, for example ammonium carbonate." Aqua ammonia is a basic or an antacid substance containing a supply of nitrogen which can be employed for neutralization.

XQ. 174. But aqua ammonia is not specifically mentioned in the '103 patent, is it, as a neutralizing agent?

A. Yes, sir, it is.

XQ. 175. Where?

A. Page 2—54—by inference, as I have said. That was an old process. But as I have tried to bring out, it uses the same phrase that was used before and gives other examples of the same thing. So by inference these substances are also mentioned.

XQ. 177. My difficulty, Doctor, is I don't see any real difference between '103 and '109. If aqua ammonia was disclosed by inference in '103 do you, as a chemist, see any difference?

A. Let's see, we are now speaking of '106 and '109?

XQ. 178. No, '103 and '109. '103 says "any basic or antacid substance containing nitrogen may be employed for neutralizing" and a specific example of ammonia is given for neutralizing, as you pointed out, in this patent on page 2, line 53, saying that it had been known that you could use aqua ammonia or ammonia in neutralizing. So I am asking you how you differentiate between the '109 patent and the disclosure of the '103 patent.

A. As regards neutralization?

XQ. 179. Yes.

A. The process of neutralization, of course, involved in the two patents is the same. The addition of ammonia in the concentrated solution in '109, that is, in feed, brings out an unexpected advantage when this regulated feeding is employed. It makes possible the use of relatively concentrated amounts of these nutrient salts with a consumption of a lesser quantity of these salts over-all, as is brought out at a number of points in the specification.

XQ. 180. Doesn't that simply mean that aqua ammonia is a good neutralizer because not only does it neutralize it but also furnishes nitrogen as a food for the yeast?

A. No, it doesn't mean quite that, it means that you actually will have to employ a lesser total quantity of ammonium sulfate and nutrient salts than would otherwise have been the case, and yet you will have maintained in the nutrient solution the relatively high desirable content of these inorganic ammonium salts, which as you see in the illustrative example is relatively high as compared with anything in Patent '103.

THE WITNESS: With respect to this neutralization idea, each of the Hayduck patents, '103, '106 and '109, describes a process of neutralizing, in so far as that was necessary.

XQ. 182. Does each of them describe different ways of neutralizing, that is, is the neutralization princip' employed in a different relation with respect to the materials used or feeding or dilution in each of these three patents?

A. I should say that the same general procedure was followed in all.

XQ. 183. But as specifically employed, is not a different procedure used, that is, the specific examples given, are they not different in each patent? '103 says to use some sugar and certain specified chemical ingredients to neutralize, the calcium carbonate; '106 gives a different formula, different parts of acids, also the molasses formula, and has the regulated feeding; that is different, is it not, from the way the neutralization is used in the '103 patent?

A. Well, the specific quantities involved are certainly different, are they not?

XQ. 184. That is what I mean. Specifically, the examples given by Hayduck of neutralization in each of these three patents are different?

A. Well, are the examples in '109 different from '106? They seem to me suostantially the same.

XQ. 185. The '109 on page 2 line 68, gives an example, an illustration, of the way that Hayduck uses neutralization; is that the same for example as in the '103 patent? I don't mean, Doctor, that they are different in principle; I am asking you about the specific example given.

A. If you will refer to the solutions, nutrient solutions, on page 1 of '109, lines 45 and thereafter, it seems to me that they are substantially the same as those in '106, page 1, lines 96 and thereafter.

XQ. 186. In '109 is the neutralization employed with regulated feeding?

A. Well, I don't want to be an obstructionist, but I don't see very clearly what the question is, the point

you are trying to make. In the '109 patent, the process given as an example by Hayduck of using neutralization is accompanied by the use of this so-called regulated feeding. In '103 the example given by Hayduck of using neutralization is not accompanied by any statement regarding regulated feeding.

XQ. 189. Now, in these patents which is the best way of employing neutralization, according to the specific examples given by Hayduck; in the '103 patent, which has no regulated feeding, in the '106 patent, or in the '109 patent? Simply if you had to use one of those different processes, Doctor, as a manufacturer, which would you use?

A. Well, I don't think that my opinion would be worth very much on that, stated so baldly. There would be so many attendant circumstances that would have to be considered.

THE WITNESS: I don't like to say I don't know which is the better. I think that if I could study it adequately and had enough information given to me, I could tell you which would be the better.

XQ. 191. Then, at the present time you do not have enough information, although you have read these patents and studied them for at least several months, you are not able to say which in your opinion is the process that is the best of these methods, using neutralization?

A. Well, of course, the Patent '109 rather appeals to you because, on purely general grounds, it does have the regulated feed, the neutralization and the use of ammonium hydroxide added along or in the feed. I think that in general, without any specific and without the necessary special information—my preliminary vote would be rather toward '109, if you are interested in that.

XQ. 192. But you are not quite sure or you are not very positive as to whether or not it is an ad-

vantage to use the regulated feeding with neutralization?

A. Well, I am prepared to stand on my answer, what I have said.

THE WITNESS: The '105 patent has regulated feeding. As far as I remember it does not say anything with respect to inorganic salts.

The '106 patent has regulated feeding. It discloses inorganic salts.

XQ. 199. Do you think the process of regulated feeding with inorganic salts and the other ingredients in Patent '106, is better than the regulated feeding, according to the Patent '105, without any limitation? If you know.

A. I think they are both equally advantageous. I think they are very good. There may be some special advantages with the inorganic salts. It is good either way I should say.

As to the difference between '106 and '109, both being regulated feeding processes, I have said before that I rather preferred '109. As to which is the best of all the processes specifically given I made certain restrictions in my earlier answers and I don't want to withdraw them by just being asked again.

XQ. 202. Turn now to the last patent in suit, Corby, et al., 1,673,735; page 2, lines 3 and following state:

> "In the practice of the present invention, an environment is created and substantially maintained which is favorable to the propagation of large yields of yeast, at the same time using smaller apparatus than was heretofore possible with the use of the very dilute nutrient solutions now generally deemed preferable. This is achieved by the use of a fermenter, in which propagation is started, containing initially only a portion of the nutrient material from which a given batch of yeast is to be manufactured."

Then, on the same page, commencing at line 101, he describes how the yeast is propagated in this fermenter, and he speaks about how fluctuation in the acidity may be compensated for from hour to hour; and they say, line 122: "at intervals generally of several hours, 'addition' is diminished or stopped, a substantial portion of the content of the fermenter is withdrawn and thereafter water, both warm and cold, is again added to the fermenter until certain of the starting conditions, particularly dilution, are substantially restored."

Does this patent state how many intervals there are except at page 3, line 12: "The interval at which yeast is to be drawn off, will, of course, preferably be some sub-multiple of the total period of propagation, such as for example, from 4 to 6 or 8 hours as conditions warrant." As the patent talks about withdrawing it at intervals, the question is, does he tell you how many intervals?

A. Yes, there is additional information on this score on page 3. Lines 108 and thereafter he suggests two periods in this instance.

XQ. 204. I notice the expression in the patent page 4, line 52, and also in all the claims in suit: "periodically." That is, there is a periodical withdrawing of some of the yeast that has been grown and a periodically starting over again. What do you understand by periodical in the ordinary sense of the word?

A. Periodical is a repetitious event, takes place in general after equal intervals of time. That is an impromptu definition.

In defendant's operations I think we may say that the great majority of the nitrogen is furnished by the inorganic ammonium salts added, the aqua ammonia, the organic nitrogen of the cereals and the organic nitrogen of molasses

As to the proportions of inorganic and organic nitrogen in defendant's process, I know what it is approximately. I have made those calculations. I cannot give you the exact figures offhand but they are approximately 50 per cent. of each.

XQ. 208. If you would like to refresh your recollection, Doctor, and have any data here, I will be glad to have you do that.

MR. WATSON: The information of Mr. Philbin's question, I think, is given in defendant's answers to plaintiff's interrogatories.

MR. PHILBIN: The information I asked was whether the Doctor knew from tests and he said that he had made tests, and as he recalled it it was of that order of 50-50.

THE WITNESS: I haven't made tests, Mr. Philbin, I have made computations from the weights of materials taken and the recognized nitrogen content.

MR. WATSON: Let me note on the record, if I may, Mr. Philbin, that the answer to interrogatory IX (c) reads: "Yes, ammonium sulfate and ammonium phosfate in amounts sufficient to give yields and proteins desired and in any event sufficient to supply more than 50 per cent. of the yeast assimilable nitrogen."

XQ. 209. I asked you with respect to the formula given in the Hayduck '103 patent to compute approximately the nitrogen-sugar ratio, and you said that you would do so. Will you also do the same at your convenience with respect to the examples given in the '106 and '109 Hayduck patents.

THE WITNESS: As to the approximate ratio of sugar to nitrogen in defendant's mash process, I think I made computations to secure those results at the

same time I computed the percentage of inorganic and organic nitrogen. I think I can secure those results for you at the same time.

MR. JOHNSON: Mr. Philbin, may I suggest it would be of assistance to the witness in making that computation on defendant's mashes if you will tell us how much more than 50 per cent. of the inorganic nitrogen was supplied by the ammonium salts so that we may have the exact figure to start with.

MR. PHILBIN: Yes, we will be very glad to do it.

I don't think, your Honor, that mathematical exactness is going to be of any importance here but we will, of course, give the witness those figures.

XQ. 210. Do you understand, Doctor, that mathematical exactnesss of proportions and temperatures and acidity is necessary to the satisfactory production of yeast or is there a fairly reasonable range of tolerances?

A. I can perhaps answer it best by saying that extreme accuracy is not required; one does not have to make the analysis with atomic weight precisions.

XQ. 211. These yeast plants operate with great quantities of raw materials, thousands of pounds of molasses and grains and large quantities of chemicals which are purchased and probably are not chemically pure, and they operate day in and day out on a large scale, so that it is a fair statement, is it not, that no great critical percentage of perfection is required; it is like any other large scale manufacturing process?

A. I should say it was quite comparable to other large scale chemical operations.

XQ. 212. You testified regarding defendant's operations in April 1931, as shown, at least partially,

in Plaintiff's Exhibit 14, containing various mash sheets, referring particularly to the flow sheet M177 dated 4/27/31.

Now, in that process there is first a preliminary treatment of the molasses and grains, is there not, during which ammonium lactate is formed?

A. Yes; in these operations the grain mash and later the mixed grain and molasses mashes are allowed to sour, and at intervals the lactic acid is neutralized with aqua ammonium, and ammonium lactate is formed.

XQ. 213. And then this solution is added to the propagating vat and the seed yeast is put in and the manufacture of the yeast commences and continues, is that correct?

A. Well, some items of procedure have been omitted in your brief statement. There have been additions of ammonia and so forth made to the nutrient solution. Other than that, by and large, that is the story.

THE WITNESS: After this solution has been put in the propagating vat, or fermenter, no aqua ammonia is added ~~so far as I can see~~ from the notations nor is any di-ammonium phosfate added. I might add that there are notations of the addition of ammonium phosfate in the wash tub, but I take it that that is after the period of propagation and involves a different operation entirely.

I testified with respect to these operations in April, 1931, that the ammonium lactate which was formed in the preliminary process and which, of course, was in the wort and was put in the fermenting tank, was a neutralizing agent which neutralized deleterious acidity. That is, namely, the ammonium lactate which I consider to be the equivalent of the neutralizing agent of the Hayduck '103 patent. I consider it to be a neu-

tralizing agent such as was contemplated in that patent. That is, the equivalent I think of the calcium carbonate which Hayduck specifically enumerates. I am a little in doubt about the word "equivalent" because I know it has patent law significance that I don't know much about, but as a practical, ordinary matter.

Ammonium lactate when dissolved in water would be a very nearly neutral salt recess. Its pH would be near neutrality, I don't know just exactly what.

There is deleterious acidity in defendant's wort during propagation. That acidity is sulfuric acid. I presume there is some lactic acid and phosforic acid. If one can include under lactic acid mixtures of organic acids I would be content to say that that is complete, that is the list, so far as I know.

XQ. 229. Which is the most deleterious of these acids, and by deleterious I mean to the growth of the yeast and the manufacture of the yeast?

A. When those acids are taken separately outside in the pure state, in general those that are the strongest are the most deleterious, those that give the highest hydrogen ion concentration. Of those that I named sulfuric acid is the strongest.

XQ. 231. Can you give us an idea of about how much stronger it is than the next stronger acid, that is, is it 10 per cent. stronger or four or five times or ten times or a hundred times?

A. It is difficult to make a simple statement like that. We cannot, in fact, make a simple statement of that kind, that is accurate. As I remember, phosforic acid is the next in strength and I would like to say that sulfuric is considerably stronger than the first stage of acidity of phosforic. Phosforic acid has a hydrogen ion constant. The solutions of phosforic acid have a hydrogen ion concentration expression in pH figures. It varies, of course, with the strength of the

concentration of the acid. One can obtain with phosforic acid, pH values considerably below 2.0 on the pH scale.

XQ. 234. Taking comparable solutions of phosforic acid and of sulfuric acid can you give us any rough idea as to how much stronger the sulfuric acid is than the phosforic acid?

A. As I have limited my answer in the past recent question, it will depend on the concentration of the acid that you are working with, that is, at sufficiently high concentrations for the same molar; on the same molar value phosforic acid will actually have a higher hydrogen ion concentration than sulfuric.

XQ. 235. Well, Doctor, suppose we take concentrations which are comparable of the same kind as those we are dealing with in these worts: if we do that can you give us some idea whether or not in such concentrations equal amounts of sulfuric acid would be greatly more acid than similar amounts of phosforic acid?

A. Well, again, if I had leisure I could tell you quite exactly the hydrogen ion concentration of let's say a one-tenth molar solution of phosforic acid, and I could tell you the hydrogen ion concentration pretty accurately of a 1/100 molar solution of sulfuric acid. Those would be concentrations that are in the range involved in these processes. I cannot do that in my head, however, nor can I do it in a few moments of computation. I shouldn't like to do it on the stand without preparation.

XQ. 236. Turning to defendant's wort concerning which you have testified at considerable length, if there was deleterious acidity there, which of these various acids that you have mentioned contribute, in your opinion, the greater part of this deleterious acidity?

A. I think that the sulfuric acid contributes the greater part, or greatest part.

XQ. 237. Have you made any test to determine which does contribute the greatest amount of deleteriousness to this acid?

A. I don't think that it would be easy to make such a test. I don't see just how you would do that.

XQ. 238. In these worts, which is present in the greatest amount, sulfuric acid or phosforic acid or lactic acid?

A. Well, that depends on the point in propagation that is involved. Early in the process there will be less lactic acid, for instance, than later in the process. The amount of lactic acid in general increases as the ammonium lactate is fed into the wort. On the other hand, at the end of the process, some of the lactic acid is consumed, so that it is not a simple proposition. But looked at by and large over the whole of the process I suspect that there is fully as much lactic acid present as sulfuric, as in the undissociated form certainly.

Lactic acid is not as strong an acid as sulfuric acid. It is weaker than the first stage of ionization of phosforic acid but stronger in the other stages. Lactic acid is a relatively strong organic acid. Lactic acid is decidedly weaker than sulfuric acid. The yeast consumes and eats up lactic acid when formed in the wort, to some extent.

THE COURT: Just a moment, please. I would like to have the two citations that were given at the beginning.

MR. WATSON: On page 7 and 8 of the record those citations are given.

THE COURT: Could I have them? Do you have them here in court?

MR. WATSON: Yes.

XQ. 243. Do you know whether or not there is any lactic acid left at the end of the process or whether it has been practically all consumed?

A. I don't think it has been all consumed, particularly if one includes under lactic acid the broad group of organic acids. I think a good deal is consumed but I don't like to give any figures as to how much.

XQ. 245. In defendant's process the first step is to treat the grain materials by souring and ammonium lactate is formed and then the nutrient solution is ready to be put in the fermenter. When that solution containing the ammonium lactate is put in the fermenter, is the solution acid?

A. It is in general acid. You mean when it is fed in? Yes, I think, judging by the figures that I could see on the mash sheets, there seemed to be an acidity present in those solutions as measured by titratable acidity. In that sense there was titratable acidity present in the solution. I don't know what the pH of the molasses was.

XQ. 246. But the solution was acid as shown by these mash sheets, and as you understand it; is that correct?

A. I am quite sure that the pH of the solution was less than 7, which would mean that it was slightly acid.

XQ. 247. What happens to the amount of ammonium lactate that is in the wort at the beginning of the propagation process, is it gradually consumed, at least a large part of it, during the propagation?

A. In which wort do you refer?

XQ. 248. Generally, any—any of these worts that are used by defendant. I understood that in all of them when the propagation commenced there was a certain amount of ammonium lactate present in the wort. I am asking you what happens to that ammonium lactate during the propagation.

A. The ammonium lactate that is present in the propagation liquid or is fed in, if you want to cover all possibilities——

XQ. 249. Yes.

MR. WATSON: Just a moment, Dr. Lamb. I want to get the question.

MR. JOHNSON: I believe, Mr. Philbin, you may be in error as to the ammonium lactate being present in the initial solution in the fermenter in regard to Plaintiff's Exhibit 13.

MR. PHILBIN: I think my question was, your Honor, whether the ammonium lactate in the wort at the time that the propagation commences—and by the propagation I mean the multiplication and growth of the yeast—what happens to that ammonium lactate during this propagation period.

A. Now that you have made your question more definite, I cannot answer it because as I understand it there isn't any ammonium lactate in the propagating wort, the dilute solution in the propagating vat at the beginning in certain of these processes. You have asked the question conditioned upon there being some in the material.

XQ. 250-1. Let us put it another way: Defendant has a nutrient solution, has it not, which contains ammonium lactate?

A. He has a nutrient solution which he proposes to feed in that contains ammonium lactate.

XQ. 252. When that nutrient solution first commences to be consumed by the yeast is there ammonium lactate present?

A. When the nutrient solution is fed in to the propagating vat and thereby ammonium lactate is introduced into the vat, if the acidity is beyond a certain point the lactate ion will combine with that

hydrogen ion to form unassociated lactic acid and the ammonium ion will persist in the solution.

XQ. 253. Taking, Doctor—because it seemed to have some difficulty here—specifically the flow sheet M177, 4/27/31, that gives certain acidities, does it not?

A. Are you asking whether the mash sheet shows a certain acidity?

XQ. 254. Shows a range of acidity, does it not?

A. Yes, in column 4.

XQ. 255. In the process used in this mash sheet, as you understand it, is there ammonium lactate in the nutrient solution?

A. Yes, the nutrient solution that is fed in—of course there are two nutrient solutions involved, and it is a little confusing unless you specify.

XQ. 256. In this case is the ammonium lactate present in both of those solutions?

A. I am not entirely sure but I think perhaps it is, because as I recall the answer to interrogatories, a portion of the filtrate from the mashes in their early stage of propagation was reserved for introduction into the propagating vat. Now, possibly that was taken, very likely it was, from either the SCT or the LCT or the IP but I have to be somewhat careful as it is not clear which is the case. But if it was taken from either the SCT or the LCT or the IP, then there was some ammonium lactate in both nutrient solutions, that originally in the vat and that fed in.

XQ. 256a. Do you know whether or not with the acidities shown as having existed during this process the ammonium lactate was consumed by the yeast?

A. I am confident that it was, certainly in part, consumed; at that stage of the propagation the ammonium would be the chief thing, almost the sole constituent consumed from the ammonium lactate in the presence of the sugar, and at this early stage in the

propagation consumption of lactic acid was probably slight, relatively slight.

XQ. 257. And in the latter part there would be more lactic acid consumed?

A. I think so, yes.

XQ. 258. Looking again at the process, the wort, that is the nutrient solution, it is acid, is it not?

A. The nutrient solution has a titratable acidity shown here. Now, as to its pH's I don't know, but I suspect it was indeed acid. I am sure it was acid.

XQ. 259. And this acid solution contains this neutral salt, ammonium lactate, does it not?

A. It probably doesn't contain a great deal of it, no. As I have just explained to you, it is probably reacted very largely, perhaps completely, to form the undissociated lactic acid and the ammonium ion.

XQ. 260. What about the solution that is being poured in during this process? Is that solution acid, and containing this neutral salt, ammonium lactate?

A. Yes, I have already answered that question.

XQ. 261. Now, as I understand it, your position is that the sulfuric acid, which is a strong acid, is present in this wort, and is neutralized, this acid is neutralized, by this acid solution containing a neutral salt, ammonium lactate; is that correct?

A. That is quite correct. That is the interesting part of it, and, of course—I want it understood that when you say sulfuric acid, it is simply the extreme acidity which it is my position and I think it is undoubtedly correct that it is contributed to by all of the acids present. The hydrogen ions that are there by themselves and are active, are divorced entirely from their respective anions, and each is an ion; it may have been derived, perhaps, from sulfuric acid, but once it is an ion it doesn't make any difference whether it came from sulfuric, lactic, or phosforus, or what.

XQ. 262. Will you please explain to me, Doctor, because I must confess I do not understand, how an acid solution (wort) containing a neutral salt (ammonium lactate) can neutralize a strong acid (sulfuric acid)?

A. I am sure I can explain that to your entire satisfaction, Mr. Philbin. Perhaps it will make it simplest for me to start with the most familiar case of neutralization and explain to you how that takes place. An ordinary neutralization of an acid by a simple base involves adding to the acid solution which contains the hydrogen ions a base. Now, a base is characterized by forming in solution OH ions. Now, OH ions have a very strong attraction for hydrogen ions, to form water, a very pronounced attraction. So that only the tiniest amounts of hydrogen and OH ions can exist together. They combine very rapidly to form ordinary water. And that is the way most neutralizations are carried out, or the simplest, we will say, I don't know that it is most, but many simple neutralizations are carried out. But there are hosts of other anions, that is negatively charged ions, like OH ions which also have a great attraction for hydrogen ions. The anions of weak acids have a very strong attraction for the hydrogen ions. Lactic acid is a moderately weak acid, as compared to sulfuric at least, and has a considerable attraction for hydrogen ions, and the moment you bring into a solution containing hydrogen ions—the moment you bring in lactate ions it removes the hydrogen ions and forms the undissociated lactic acid, which is not acidic in its nature. To be sure this lactic acid can give titratable acidity, but it doesn't give hydrogen ions. And so you see it is not necessary at all to have an alkaline solution, to bring about neutralization, quite the reverse. It is perfectly easy to have an acid solution which will, when added to another acid solution,

neutralize the hydrogen ion concentration; and that is precisely what happens here. It is a perfectly well-known phenomenon. There is nothing strange about it.

XQ. 263. Can an acid neutralize another acid?

A. An acid anion can, and does constantly. It is one of the most important neutralizing agents in the universe.

XQ. 264. Then as I understand you, when you say neutralization it would include the interaction, it might include the interaction, of two acids, although the result would still be acid, is that correct?

A. Providing it involves the interaction of an acid and the salts of an acid. I don't think you can get any neutralization by just mixing two acids together, but if you mix together the salt of a weak acid with a solution that is acidic, you will have prompt and effective neutralizations, one of the most important means of neutralizing. It is nothing novel that I am disclosing; it is a perfectly general thing.

XQ. 265. In defendant's wort there is this deleterious acid as I understood your statement, and you have said that ammonium lactate did neutralize, at least partly, that acidity. Is there anything else in defendant's wort which in your opinion counteracts the acidity?

A. Yes; I think that there are some additional salts of weak acids, not very different from lactic acid, which exert a similar effect. As to what are some of them, I suspect that there was some potassium lactate from the molasses and potassium succinate, potassium oxalate, various substances from the molasses. I think there are similar substances from the grain.

XQ. 269. Are there any other substances in addition to this ammonium lactate and the molasses substances and the grain substances which, in your opinion, counteract or tend to counteract this acidity?

MR. JOHNSON: Are you still talking about mash M177?

MR. PHILBIN: Yes.

A. I think you have covered all the materials from the grain and the molasses and the inorganic salts; I think that's all.

XQ. 270. Do you know how much these molasses substances and these grain substances and the ammonium lactate respectively contribute to this so-called counteracting or neutralizing effect, approximately?

A. I don't want to attempt a quantitative or even a roughly quantitative statement on that score, but I am sure there is some and a significant amount, I am willing to say that. Which contributes the most all depends, because it varies markedly in the different mashes.

XQ. 272. Do the molasses and grain substances contribute more or less, in your opinion, to the ammonium lactate?

A. I would have to look into that for that is not easy to answer offhand. I should think mash 177, I should be inclined to guess, although I must preface that by saying it is just a guess, because I cannot tell, that the ammonium lactate was the more important, as far as amount was concerned, certainly, than the other things present. By amount I mean the amount of neutralizing effect.

XQ. 274. But you made no tests or investigations to determine how much each of these three things contribute to counteracting acidity in any of the defendant's mashes or similar mashes, have you? I don't want to burden you, Doctor, by guessing or speculating; if you haven't investigated that you can say so and I will not pursue this question further.

A. Yes, we have made some tests on solutions prepared as nearly as we could, corresponding to these

worts in order to form our estimate as to the neutralizing power. Our conclusions were that the ammonium lactate that was present had a marked and significant neutralizing effect over and above the neutralizing effect of materials already present in molasses.

XQ. 276. That doesn't give me a very clear idea, Doctor, when you say marked and significant effect over the neutralizing effect of the molasses and the grain materials. Did these investigations that you made give you anything more definite as to percentage, 10 per cent., 100 per cent., 20 per cent., in reaching the conclusion that there was "a marked and significant effect?"

A. No, we didn't measure the thing in percentages so that we could say in percentages or definite fractions. That is why I hesitate to answer.

XQ. 277. If the total neutralization was 10 per cent. and the amount contributed by ammonium lactate was 5 per cent. would you consider that "marked and significant"?

A. Why, it might be; it would depend on the acidities that prevailed and the neutralization that was obtained, that is, how much the pH diminished.

XQ. 278. Five per cent. would that be "marked and significant"?

A. Five per cent. of the pH, is that your question?

XQ. 279. Yes, taking the pH as a scale.

A. Well, I dislike to express it that way because I know we didn't express it that way and I don't know as I can give it to you that way. But without ammonium lactate the pH values were low in the sense of markedly acid; with it it was not so low.

XQ. 280. What is the average pH value in defendant's wort, approximately?

A. Well, I don't carry those figures in my head and I don't think it is advantageous for me to try and

remember about an experiment that was performed a good while ago at my solicitation and under my observation, in which these propagations were treated, but I think that we can supply you with those figures.

XQ. 281. Yes, I would be glad to have them because you testified that with the ammonium lactate the pH value was higher, and I would like to know how much higher it was according to your investigation because "significant" does not really mean very much to me, Doctor. I might think something was significant and you might think something different. But you will give us those figures?

A. Well, I don't know that I can give them to you today but before the conclusion of the trial I can.

XQ. 281-2. Is there a range of acidity or pH in defendant's wort during the propagation period or is it always at the same level?

A. I think the pH does change as propagation progresses.

XQ. 283. Do you know how much the acidity or pH changes, approximately?

A. Again, that will all be evident from the figures that I will give you.

XQ. 284. Referring now to defendant's operations in December, 1932, as evidenced in part by plaintiff's Exhibit 15, and considering the flow sheet 3539 in that process, as I understand it, there was ammonium lactate produced during the souring process as before and in addition there was added during the propagation di-ammonium phosfate; is that correct?

A. That is correct.

XQ. 285. And you stated, I believe, that this di-ammonium phosfate was also a neutralizing agent which neutralized deleterious acidity, is that correct.

A. That is correct.

XQ. 285-a. Now, looking at this flow sheet 3539, (Exhibit 15), that shows a range of acidities of the wort during the propagation period in the column headed "Acidity"? And in that column headed "Acidity" the figures run from 1.6, 2.6 and so on ending with 2.5. Do you understand that these figures show the acidity and that the larger figures show more acidity than the smaller figures, that is, the 2.6 would be more acid than 1.6?

A. It would have a greater titratable acidity. Whether it would have a higher pH doesn't necessarily follow.

XQ. 286. This column of acidity shows it is a slight acidity, 1.6, when the propagation or process commenced, and then at ten o'clock in the column marked D there is the figure 8. Do you understand that to mean that at that point 8 pounds of di-ammonium phosfate were added?

A. At actually, I think, about 9:30 there is a notation of 8 and a check, which I think indicates that 8 pounds of di-ammonium phosfate was added. Then the 6 beneath it indicates that 6 more pounds of di-ammonium phosfate was added. Opposite those additions there are the acid figures, both before this so-called neutralizing agent was added and also after it was added.

XQ. 289. Is there any substantial difference in the acidity shown after the so-called neutralizing or ant-acid substances were added?

A. The titratable acidity remains the same from 10 o'clock on. Of course, we don't know what happened to the titratable acidity between 9:30 and 10 o'clock, nor between 11:30 and 12:00. But we do know that half an hour afterwards the titratable acidity was the same. Either acid was neutralized or and possibly additional acid formed, so that the net effect was to show no

change in tritratable acidity. Here again we know nothing about the pH.

XQ. 290. Turn now to the next mash sheet, 3540, where some more of this so-called antacid or neutralizing material was added, there again in the column under D there was added 8 pounds, and very shortly thereafter 6 pounds of di-ammonium phosfate. Before the addition, the acidity was 2.4. It remained 2.4 after adding 8 pounds, it remained 2.4 after 6 pounds were added, it remained 2.4 at the end. Do you consider that sheet shows any change with respect to acidity, by adding the so-called neutralizing agent?

A. Certainly these figures don't show any change, that is entirely true. They remain the same; and in so far as these figures are concerned, there is no evidence of a change in the amount of titratable acidity in this solution. Whether that indicates there has been no change as a result of the addition of 6 pounds or whether it is a balanced change, doesn't appear from these figures; but of course, I am confident that the neutralizing effect of the 6 pounds of di-ammonium phosfate did indeed so operate, indeed, it could not avoid so operating, as a chemical necessity.

The yeast gets food from the di-ammonium phosfate. It can get both nitrogen and also some phosforus. Whether it at that stage in the propagation required any more phosforus, or whether indeed, it required more nitrogen at that stage isn't certain. It is probable that it did take up more nitrogen. Whether it took up more phosfate I can't say.

XQ. 293. Can you point out in any of these flow sheets, Doctor, of these December, 1932, operations, any indications that the titratable acidity, which is the only thing shown on these sheets, was substantially changed by the addition of di-ammonium phosfate?

A. Yes. I can show two or three such cases. For instance, on Mash Sheet 3539 opposite "2 o'clock"

there is the acidity figure 2.6. Opposite "3 o'clock" the acidity figure 2.4. Between those two periods 15 pounds of di-ammonium phosfate had been added. There is a drop in the acidity. It is probably a greater drop even than appears, because as can be seen by examining mashes comparable to it where such additions did not take place, the acidity rises rather sharply during the first few hours propagation. A similar situation exists in Mash Sheet 3540, where at 3 o'clock the acidity was 2.6, 15 pounds of di-ammonium was added, and at 4 o'clock it dropped to 2.4. Another instance of the same thing occurs on Mash Sheet 3542, at 5 o'clock and 6 o'clock, respectively. Similarly, at 6 o'clock and 7 o'clock on Mash Sheet 3543.

During all those times there was lactic acid in the solution and phosforic acid.

XQ. 295. Was the lactic acid and phosforic acid being consumed by the yeast, thereby reducing the acid content?

A. Minute amounts of both might have been consumed during that period.

XQ. 296. That would have made the acid figures less, would it not?

A. Not materially so, in the presence of the stronger acid. I will change that. I will say yes, they would have made it less. Please cross out the first answer. But not greatly.

RE-DIRECT EXAMINATION BY MR. WATSON:

RDQ. 297. Referring to these mash sheets, for example 3539, I understood Mr. Philbin to ask you with regard, for example, to the addition of 8 pounds near the bottom of the page, in the column D, after an acidity figure had been entered, and then to call your attention to the following acidity figure. Do you know how long an interval was represented between those acidity figures?

A. I think one hour. I would like to point out in that connection a thing that I didn't notice before when Mr. Philbin asked me. As a matter of fact, we don't know what the acidity was at 9:30, I think perhaps I did bring that out, but not clearly, when the 8 pounds was added. It may well have been it was still 2.7, in which case the 8 pounds did produce a drop in the acidity, titratable acidity.

There isn't anything to show on the sheet what it was immediately after the 8 pounds was added, but I have just pointed out that it may well have been still 2.7 before addition, and it may have dropped to a low point after addition.

RDQ. 300. In defendant's operations during the yeast propagations, the operations as reflected by the exhibit mash sheets, does the acidity rise as high in the propagating vat as it would have risen if no added neutralizing means had been employed?

MR. PHILBIN: I understood the Doctor was going to give us the figures as to that.

MR. WATSON: I am speaking of hydrogen ion concentration.

A. No; the hydrogen ion concentration, as disclosed by pH values, was unquestionably lessened as a result of the addition of the neutralizing substances, unavoidably lessened.

RDQ. 302. In your opinion would such increased and assumed unneutralized acidity have been deleterious in the yeast manufacturing processes otherwise shown on these mash sheets?

A. Yes; that is my opinion.

RDQ. 303. In defendant's operations as shown by these mash sheets during the propagation, in your opinion, would there be present a deleterious acidity in the solution if there had been no inorganic salts, such as ammonium sulfate, used?

A. No, I don't think there would have been.

RDQ. 304. Please turn now to Plaintiff's Exhibit 1, which is the '103 patent in suit. You were questioned as to the paragraph beginning in line 51 of page 2. Can you state whether there is any yeast propagation occurring at the time spoken of when ammonia may be added for neutralizing some of the lactic acid?

A. No, in this paragraph beginning line 51 which you mention the patentee is describing the process that takes place antecedent to any yeast propagation.

The purpose of adding ammonia at that time was by a momentary removal of the acidity to promote the formation of more acid; in other words, to increase the production of acid by the organisms. That is lactic acid from lactic acid bacteria. Of course, these are organisms quite distinct and remote from yeast and involves the conversion of the sugar into the lactic acid by these organisms.

RDQ. 308. Will you please turn to Plaintiff's Exhibit 2, which is the second patent in suit, '105. You were asked this morning whether there was anything in this Hayduck patent "which tells you what that particular rate should be," referring to rate of feed, and you answered, "Nothing other than what I have told you and what would be known to the skilled operator." Will you refer to the sentence beginning in line 66 of page 1 which speaks of the preparation of a wort "having, for example, a gravity of 12° Balling" and to the phrase a little further down in the paragraph which speaks of taking a portion of the wort and diluting it to "for example, to about 1° Balling" and to the matter at the end of the paragraph which speaks of the mean Balling as between 3 and 5 degrees and to the matter at the end of that page and the top of page 2 which refers to the feed and says that "there is always a wort concentration, by means of which the nutrients and the resultant substances are absorbed most

efficaciously and quickly by the yeast" and to the illustrative reference beginning at line 84 of page 1 which speaks of the possibility in the case of the aeration process for ten hours that the addition may be continued for seven to eight. Now, from all of those can you express any opinion as to the construction of the patent on this matter of rate of feed?

A. Yes, I think I can. I would like though to have that answer that I made that you just read read again to me.

RDQ. 309. I will show you the record. The question is there (indicating).

A. Yes, I can say from these citations that while I covered some of these points in my testimony that evidently I didn't cover all of them. I thought I had mentioned most of them but I see at least two here that I didn't mention. The definition of the concentration of the two solutions and the special definition regarding a mean content, and finally the statement as to the duration of the addition, it is told pretty definitely to a person skilled in the art what feed should be maintained, what the rate of feed should be, and then there is the very significant statement to which you called by attention, line 105 at the bottom of page 1, which I may have mentioned incidentally but not specifically, to the effect that "there is always a wort concentration, by means of which the nutrients and the resultant substances are absorbed most efficaciously and quickly by the yeast." Now, that, of course, does very clearly state that the operator should control the addition of his concentrated solution, that is, should adjust his rate so that foodstuffs could not accumulate in the propagating solution and that can readily be told by watching the density, that is, the Balling of the nutrient solution, an observation that all yeast makers were in the habit of making. So that by this simple ob-

servation the operator could easily control his additions and secure the advantages of the regulated feed about which I have spoken.

MR. WATSON: If the Court please, with the consent of defendant's counsel we intend to offer as an exhibit a table showing market prices of various ingredients and commodities which have been referred to by the witnesses in their testimony over a period of thirty or thirty-five years, and subject to the offer of that table plaintiff rests.

DEFENDANT'S PROOFS.

WALTER RAUTENSTRAUCH, called and sworn for the defendant, testified as follows:

MR. PHILBIN: Defendant offers in evidence as Defendant's Exhibit D-1 a book of references containing the following patents and publications, viz:

United States. Lavedan, 1,201,062, Oct. 10, 1916, page No. 1.

British. Polsky, 20,787, 1892, page No. 6. Jacqueman, 21,011, 1896, page No. 10. Mohlant, 11,617, 1913, page No. 15.

German. Rainer, 10,135, 1879, translation, page No. 17.

French. Roth, 470,925, 1914, transl., page No. 25.

Swiss. Pollak, 65,539, 1913, transl., page No. 32.

Austrian. Fritsche, 45/4047, 1895, transl., page No. 36.

Abstract of Iwanowski article, Journal of Society of Chemical Industry, 1903, page No. 40.

Abstract of Henneberg article, Journal Society of Chemical Industry, 1908, page No. 41.

American Distillers Review, 1914, page No. 43.

Pure Products Magazine (New York) 1908, page No. 44.

Brenner article, Centralblatt f. Bakt. 1914, transl., page No. 51.

Wilfert article, Presshefe Kunsthefe und Backpulver, 1890, transl., page No. 54.

Delbruck article, Wochenschrift fur Brauerei, 1903, transl., page No. 58.

Lafar, Handbuch fer Technischen Mykologie, 1905-1907, transl., page No. 63.

(Book received and marked Exhibit D-1.)

MR. PHILBIN: And as Defendant's Exhibit D-2 a book entitled Foreign Patents and Publications, containing copies of the German, French, Swiss and Austrian and other foreign language references, translations of which are in the book Defendant's Exhibit D-1, viz:

German. Rainer, 10135, 1879.

French. Roth, 470,925, 1914.

Swiss. Pollak, 65,539, 1913.

Austrian. Fritsche, 45/4047, 1895.

Brenner article, Centralblatt f. Bakt. etc., 1914, p. 555.

Wilfert article, Presshefe Kunsthefe und Backpulver, Vienna, 1890, pp. 192-195.

Delbruck article, Wochenswift fur Brauerei, Jan. 18, 1903, Vol. 20, No. 3, p. 25.

Lafar, Handbuch der Techischen Mykologie, Jena, 1905-1907, Vol. 4, pp. 131, 132.

(Book received and marked Exhibit D-2.)

MR. WATSON: With respect to the two sets of documents offered, plaintiff notes that they contain the United States Patent Lavedan 1,201,062, which has a filing date later than the effective dates

of invention for the four Hayduck patents in suit, and this Lavedan patent is not pleaded against the fifth patent in suit, the Corby and Buhrig patent; and the documents also include an article, an extract of an article, by Iwanowski and excerpts from a book by Lafar, neither of which has been pleaded by the defense against any of the patents in suit.

Objection of these exhibits pro tanto is accordingly taken by plaintiff.

MR. PHILBIN: With respect to the Lavedan patent, it is not offered as a reference or with respect to the last of the five patents in suit, namely, the Corby, et al. patent. As for the other patents, it is entitled, as we contend, to a date which was the date of the filing of the application for the Lavedan patent. That is a question of law as to what date Lavedan is entitled to, whether he is entitled as a part of the art or anticipation to the date of filing the application or to the date of——

THE COURT: Well, as I understand it, the major difficulty is that you haven't pleaded it; is that it?

MR. WATSON: Lavedan was pleaded, if the Court please, but it is too late in date,—even the filing date, Mr. Philbin, is a year late.

THE COURT: He says it is a question of law as to the filing date.

MR. PHILBIN: Is there any contention that the disclosure of the Lavedan patent as issued is not substantially the same as that of the application as filed?

MR. WATSON: We don't know, we haven't seen that file wrapper, but the filing date itself is a year late, you notice.

MR. PHILBIN: It is a year late, your Honor, for the 1915 German filing date. There is a question as to whether or not the Hayduck patents are entitled to that particular date. I think we can determine the legal effect of that after we know what date Hayduck patents are really entitled to.

THE COURT: How large a part does that play here in the issues here, these patents that you are objecting to?

MR. WATSON: We don't know yet.

THE COURT: Wouldn't it be well to let them in subject to striking them out?

MR. WATSON: I think so.

THE COURT: Yes, let them in; you reserve the right to strike them out at the end of the case.

MR. WATSON: This particular item is not in the prior art and the others are not pleaded.

THE COURT: In these cases, if you haven't properly pleaded, the Court will allow an amendment, unless you are taken by surprise, but as I understand it, they are well and sufficiently pleaded.

MR. PHILBIN: Yes, your Honor. First, there is no question about surprise. Counsel says that they——

MR. WATSON: Oh, we concede we are not surprised; indeed, our surprise is from a different direction. Our surprise rather is that they find themselves back into the case, because they were in the Federal litigation and had apparently been discarded by the defendant here as of so little interest that they didn't plead them. Our surprise is only that they changed their mind at this hour.

MR. PHILBIN: We haven't changed our mind.

THE COURT: I will allow them in subject to the right to strike them out in the event that it be shown that they are not properly before the Court and that will depend on the evidence in the case.

DIRECT EXAMINATION BY MR. PHILBIN:

My name is Walter Rautenstrauch; residence Palisade, New Jersey. I am a consulting engineer and also professor of engineering in Columbia University. As to what technical education I have had, I have obtained Bachelor's, Master's and Doctor's degrees. I graduated from University of Missouri and University of Maine and did graduate work at Cornell University. I am a Fellow of the New York Academy of Sciences, Fellow of the American Association for the Advancement of Science, member of the American Society Mechanical Engineers. I have had practical experience in yeast manufacture. I was in charge as vice-president and general manager of the Liberty Yeast Corporation. I was with the Liberty Yeast Corporation from 1923 to 1926, when it was sold. The offices were in New York City, the plants were located in Cambridge, Massachusetts, Baltimore, Maryland, Pekin, Illinois and sub-stations throughout the various parts of the United States. Relative to the Fleischmann Company it was not a large manufacturer of yeast during that period, but it did have a considerable distribution of yeast. I have visited European yeast plants both in Germany and Austria.

I have read the Hayduck patent, 1,449,103, and I believe I understand it. This patent describes the use of an antacid, that is, a basic or an alkaline material, to neutralize undesired acidity. It describes two different applications of this principle of neutralizing undesired acidity in yeast manufacture. The first step

in which this principle of neutralizing too much acidity is employed is the use of the calcium carbonate for neutralization of the acid.

Q. 15. I did not make myself clear, Doctor. In the process of yeast manufacture there is, as we understand from the testimony, when grain is used, the first step of souring the grain to get its materials in proper condition to be consumed by the yeast, and then there is a next step of having the yeast consume those materials. What is the first step which the patent speaks of as using this principle of not having too much acidity?

A. The first step is the addition——

Mr. Watson: Mr. Philbin, may I ask you to make the question more definite? I don't understand what yeast-manufacturing process you are referring to.

Q. 16. What do you understand by the process of yeast manufacture, Doctor, as related to this Hayduck patent?

A. The process is in two parts, one which consists of preparing the nutrient solution for the mash, and the second part is that which concerns the growing of the yeast in fermenters.

The patent applies this neutralizing principle or speaks of using this neutralizing principle with respect to both of those steps, first preparing the grain and second, actually growing the yeast with the prepared substances from the grain.

Q. 18. Where does it describe neutralizing in this preliminary step of getting the grain ready so that its materials can be consumed by the yeast?

A. In line 61, page 1, it refers to the acid components set free during the yeast propagation and suggests that neutralization of these acid components by calcium carbonate may suitably be employed.

By The Court:

Q. 20. Just a moment, before you finish that question. As I understand it, Doctor, you say that this patent, which we have been referring to as '103, Hayduck, discloses two processes to overcome acid; is that correct?

A. Yes, not two processes, your Honor, but it refers to the neutralization of the acidity in the two processes which are used, or two steps of the processes, which are used in the manufacture of yeast; one is the preparation of the mash and the other is the propagation of the yeast in the fermenter.

Q. 21. Well, then, does it or does it not disclose two processes for overcoming acidity?

A. It describes a single process for the overcoming of acidity used in the two steps in the manufacture of yeast. Does that make it any clearer, sir?

Q. 22. Two processes in one of the steps, is that what you mean?

A. I mean, sir, that it describes the neutralization of the acid and how that neutralization is accomplished by the calcium carbonate. This neutralization takes place in the two steps of the process; one is the preparation of the mash before the mash is fed into the fermenter where the yeast is grown, and the other step, the second step, is when the yeast is being grown in the fermenter. So that the same method is used in the two steps of the process.

Q. 23. Then from that I take it, there is but one process employed in this patent to overcome acidity?

A. I think your difficulty arises due to the use of the term "process" in reference to the process of yeast manufacture and the process of neutralization.

Q. 24. Well, when I refer to "process" I mean more of the factors that are exerted in producing yeast, under the formula disclosed, or the process disclosed, in the patent.

A. Then, sir, there are two processes, and the neutralization takes place in each of these two processes; but the method by which——

Q. 25. But the processes are not the same?

A. But the method by which the neutralization takes place is the same in the two processes.

Q. 26. But they are done in a different way, is that it?

A. They are done in the same way.

By Mr. Philbin:

Q. 27. In a yeast plant, Doctor, is it usual and, indeed, always the case from your experience, to have this first step, that is the step of fermenting the grains, of preparing the grains, physically close to the second step of growing the yeast in a large tank or fermenter?

A. That has been the experience, it has been my observation, sir. In this first tank—that contains the grains and cereals which it is desired to treat in order to put the materials in proper form to be eaten by the yeast—there is lactic acid. It is desired not to have too much acidity in that first tank.

Q. 31. I show you a rough sketch of a so-called grain tank and a fermenter tank, there being shown in the grain tank the grain and bacteria, the bacteria being capable of producing lactic acid, and underneath that sketch of the grain tank is stated "lactic acid and ammonia," while in the fermenter tank, which is where the yeast is grown, are the words "sugar and ammonium salts" while underneath that tank are the words "sulfuric acid and ammonia." Now, will you please describe in reference to that sketch what is this process of yeast manufacture which involves the use of those two tanks and neutralization with respect to each of them.

A. The grain tank refers to a process in which the grain material is peptonized by the use of lactic acid

bacteria and in the grain tank the growth of the lactic acid bacteria is liable to produce what is called a condition of overacidity. The ammonia is added for the purpose of neutralizing the overacidity forming ammonium lactate. In the case of the fermenter tank, using sugar and ammonium salts, the sugar usually derived from molasses is prepared by boiling with sulfuric acid and this sulfuric acid is for the purpose of eliminating bacterial growth and purifying the molasses, and ammonia is also added in the form of ammonium salts for the nutrient solution of the wort, so that there will be supplied nitrogen in the growth of the yeast, and ammonium sulfate is formed as a result of its action with the sulfuric acid.

MR. JOHNSON: May I ask if the witness means that the ammonia is added there in forming ammonium salts?

A. In the grain tank the lactic acid bacteria is operating to form a greater acidity and the ammonia may be added in that tank. The ammonium salts are added in the fermenter tank in which the molasses and sugar are employed.

Q. 32. Is there this difference between the neutralization in the first step, namely, with the grains, and neutralization in the second step, namely, that in the first step what is neutralized is lactic acid and in the second step what is neutralized is sulfuric acid or other acids which come from the ammonium salts?

A. That is quite correct.

Q. 33. And in both cases exactly the same neutralizing material is employed, the basic material, namely, ammonia?

A. That is correct.

MR. WATSON: I hesitate to object but it seems to me counsel is giving most of the testimony in his questions. That is very leading.

MR. PHILBIN: Defendant offers in evidence Defendant's Exhibit D-3, the sketch referred to.

(Received and marked Exhibit D-3.)

THE WITNESS: Ammonia is a very good yeast food. It furnishes the nitrogen to the yeast. Ammonium lactate is also a good food for the yeast and furnishes the ammonium. It also furnishes carbon content from that complex series of chains which lactic acid contains.

Q. 39. Refer now to the second Hayduck Patent 1,449,105. Have you considered that patent also?

A. I have.

Q. 40. This patent has been referred to as the regulated feeding patent and it states on page 1, lines 54 to 64: "In the process described hereinafter and forming the subject of this invention, the goal of obtaining a high yeast yield with little or no formation of alcohol is reached by the use of worts of normal quality and concentration, the wort being added to the yeast continuously and at a rate such that no large excess of alcohol will be formed, and the yeast can assimilate most of the alcohol which is so formed." In worts of the types that we have been considering, what controls, among other things, and chiefly controls the question of whether you are going to get a large amount of alcohol or a large amount of yeast?

A. The chief factor in the production of yeast as compared to alcohol is the sugar content, and with a low sugar content in the wort more yeast is grown, relatively, and less alcohol.

THE WITNESS: That means that beyond a certain percentage of concentration of sugar in the solution, that percentage varying with the presence of other substances in the wort, beyond that percentage a tendency to form alcohol exists; below that percentage the tendency disappears.

Q. 42. This Hayduck patent says the wort should be added "at a rate such that no large excess of alcohol will be formed." Do you find anywhere in the patent any statement as to what that rate should be other than that there should not be too much sugar formed?

A. I find no specific reference to the rate in terms of rate of flow but the rate is to be as instructed in the patent so that there will be no large excess of alcohol.

Q. 43. What would determine in any given wort how much sugar there was at one time, that is, whether or not there was more sugar than the yeast would use for its growth or for reproduction?

A. The amount of sugar you put in.

That would depend upon the amount of materials you use, and the temperature and other things.

Q. 45. The patent also states at the same point: "The yeast can assimilate most of the alcohol which is so formed."

Does yeast in the ordinary wort, such as those we have been considering, consume or assimilate alcohol?

A. That is a very much debated question, sir. Many people believe that it does not assimilate alcohol because, having excreted alcohol, it seems illogical that it should then use it as a food. But it is a debated question.

I have been able to discover no evidence that yeast, when it has sugar which it can eat, consumes the alcohol which the yeast has excreted from sugar. If it does take place, it is so small that we are not able to measure it. I think it would have no practical importance.

Q. 48. This patent on page 1, lines 90 to 95 says: "The quantity of the diluted wort which is originally available for the yeast is so chosen, for example, that the mean content of the entire wort employed would be 3 degrees to 5 degrees Balling."

What do you understand by the mean content of the entire wort employed, which Hayduck says to be about 3 or 5 degrees?

A. I would understand that to mean, sir, the wort employed in the fermenter, because, obviously the percentage of Balling has significance only in the fermenter where the yeast is grown. I would, therefore, assume that the 3 to 5 per cent. Balling would be that Balling which is to be maintained in the fermenter during the propagation of the yeast.

Q. 49. Upon what does the amount of alcohol depend, upon the amount of sugar in the fermenter at the time that the yeast is consuming it, or upon the amount of sugar that may be in some reserve tank?

A. Well, obviously it would be the amount of sugar in the fermenter in which the yeast is being grown.

Q. 50. And that is what you understand Hayduck to mean by this passage, namely, he is interested in the amount of the sugar, the mean content of the wort, which the yeast is feeding upon?

A. Naturally, because that is the whole thing toward which this description is addressed.

Q. 51. Please refer to the Wilfert article, Presshefe Kunsthefe, on page 34 of the booklet Defendant's Exhibit D-1?

THE WITNESS: This article describes generally a preliminary mashing or preparation of the grain by lactic acid or by sulfuric-acid means.

Q. 53. If you will turn to page 3 of the article, page 56 of the booklet, I find the statement:

> "The yeast plant requires for its vigorous growth a liquid which is slightly acid; apart from the fact that this constitution of a liquid promotes the development of the yeast plant, it renders the development of fission fungi almost entirely impossible, inasmuch as the latter, as experience has

shown, can thrive well in neutral and alkaline liquids, but cannot develop in acid liquids."

Is that a correct statement with respect to yeast propagation, that you should have a slightly acid solution?

A. That is correct, sir. That slight acidity is maintained in practice by neutralization, as there is a tendency to increase the acidity during the processes of manufacture.

MR. JOHNSON: Pardon me, is the witness speaking of 1890, the date of this publication, or some other date?

THE WITNESS: I am speaking about the process in general, that when there is——

MR. JOHNSON: As to what date, may I ask?

THE WITNESS: I am speaking with reference to the question which was asked me, what is done in the neutralization of acids as yeast is grown.

Q. 55. Doctor, if you read a teaching that any solution should be slightly acid, what would that mean to you, as a chemist, with respect to how to keep it at that point of slight acidity?

A. It would mean that you would control the acidity by the well-known means of reducing acidity through neutralization. That is an old practiced art. And if it wasn't acid enough I would put in more acid.

Q. 57. Turn next to the Pollak Swiss Patent 65,539. This patent is entitled, "Process of acidifying fermenting substrates by the use of ammonium compounds." What does "fermenting substrates" mean?

A. Fermenting substrates means the fermenting material which is carried on or used in the propagation of the yeast. Substrate is a rather odd term that they

use there, but they probably mean mixtures, fermenting mixtures.

This patent describes the lactic-acid fermentation, that is, the preliminary treatment of grains with lactic acid and ammonia which I have already referred to.

Q. 59. On page 2 at the top it is stated: "True enough, it is already known to add ammonium compounds, e. g., ammonium carbonate, to the fermenting substrates for increasing the nitrogen content of the fermenting substrates. As a result of the addition, soluble salts of the acid formed by the fermentation are produced which not only promote the often necessary diastase effects in the processes under consideration, but also constitute excellent nitrogen-supplying nutrient salts for the growing yeast."

What salt would be produced by the addition of ammonia to this lactic-acid fermentation?

A. Those that are naturally produced are ammonium lactate.

Q. 60. The description in the single claim of the patent is as follows: "Process of acidifying fermenting substrates by using ammonium compounds, characterized by this, that the latter are repeatedly added to the fermenting substrates for repeated partial neutralization of the acid resulting from the fermentation."

THE WITNESS: That is a brief statement of the gist of this patent.

Q. 61. Please refer to the Brenner article in Centralblatt f. Bakt. 1914. That article is entitled "The Nitrogen Nutrition of Mold Fungi." What are mold fungi and what relation, if any, do they have to yeast?

A. Mold fungi exist in great variety, there are tens of thousands of fungi that are similar in their behavior, in their growth particularly, to yeast, which is a unicellular organism and exhibit many of the charac-

teristics of yeast in their growth, particularly as to the conditions under which they are grown. This article deals generally with the growth and the kind of food, etc., that these mold fungi or some of these mold fungi may have. On the second page of the translation there is the statement in the first sentence of the second paragraph on the second page of the translation: "Inorganic NH_4 salts are good sources of N (nitrogen), provided the accumulation of free mineral acid is prevented by the addition of $CaCO_3$." NH_4 means ammonium. So that means inorganic ammonium salts. $CaCO_3$ means calcium carbonate. That is an alkaline material.

Q. 67. Now turn to the abstract of W. Henneberg article in the Journal of the Society of Chemical Industry 1908, which should be at page 41 of Defendant's Exhibit D-1. The abstract commences: "The author has carried out an extensive series of experiments." Who do you understand is meant by "the author"?

A. That is Dr. Henneberg. This is merely an abstract by someone who has read that Henneberg article, as I understand it.

Q. 69. "The author has carried out an extensive series of experiments which show that rye or wheat-meal, egg albumin, peptone, lecithin and inorganic ammonium salts exhibit striking similarities in their action on yeasts," and it is stated, "The substances are (4) non-poisonous in sucrose solutions, if calcium salts, carbonates or bases are present in small amounts or other salts, (such as acid potassium phosphate, magnesium sulphate, sodium sulphide, sodium formate or potassium sulphate) in higher concentrations; (5) of great nutritive value in presence of the substances mentioned under (4)."

What is meant by sucrose solution?

A. A solution containing sugar, wherever it comes from, molasses or what it may come from.

Q. 71. Why do you understand that these "inorganic ammonium salts" are not poisonous in these sugar solutions?

A. It just so happens that in the presence of the sugar, affinity of the yeast for the sugar will make the salts inoperative, whereas if there is no sugar present the salts will have a deleterious effect on the yeast cells.

Q. 73. In that statement it is said that these "inorganic ammonium salts" are not poisonous in these solutions if calcium salts, carbonates or bases are present. What happens in these solutions if calcium salts, carbonates or bases are present at the same time as these inorganic ammonia salts exist?

A. As the yeast cell avails itself of the nitrogen content of the ammonia salt the calcium acts to combine with the other radicals so as to prevent the formation of acid, neutralizes the acid component.

Q. 74. The statement contains the following about halfway down: "Under ordinary conditions, these nitrogenous substances form excellent nutrient materials for yeasts, their injurious action only appearing in the absence of certain salts, which are more especially compounds capable of neutralizing acids."

What are the "certain salts" which you understand are referred to there as capable of neutralizing undesired acidity arising from the use of inorganic ammonium salts?

A. Well, any of the bases which will act as neutralizers of the acid. There are a great many of them.

Q. 75. The article states: "It must, therefore, be assumed that the nitrogenous compounds give rise, in the interior of the cells, to free acids, which, under normal conditions, are immediately rendered innocuous by the above-mentioned salts, if such salts are lacking, the acids exert a poisonous action on the cells. In the case of ammonium salts, these must undergo decomposition in order to take part in the formation of pro-

teins, the acid of the ammonium salts being liberated; if, therefore, this acid has a poisonous action on yeast, the corresponding ammonium salt will have a similar action."

What is meant by "the nitrogenous compounds" in the first part of that paragraph?

A. All those nitrogenous compounds which are available to the yeast, which are tied up with an acid radical. As the nitrogen is availed of, that part which forms a free acid is deleterious.

Referring to the article in the "Pure Products" Magazine, which should be at page 44 of defendant's booklet, D-1, that article also relates to what the author understands to have been some work of Henneberg; in fact, I think it is the same article that is reviewed, or both articles are derived from the same primary article written by Henneberg, disclosing the results of his investigations.

Q. 77. On the first page it is stated under the heading of conclusions that:

> "From the reported results of investigations it is apparent, that flour, egg albumen, peptone, lecithin and inorganic ammoniacal salts in their influence upon yeast, exhibit striking resemblances, which above all, show themselves in the following particulars:" and among those particulars are the following:
>
> "4. Not toxic, as soon as lime salts, carbonates or bases are present in the sugar solution in very slight amount, or other salts in greater concentration.
>
> "5. In the presence of these substances they are mostly of excellent nutritive value."

Do you consider that to be a correct statement?

A. I do.

Q. 78. The defendant employs in its process molasses and grains, and inorganic ammonium salts. Was it old before Hayduck to use such materials in yeast manufacture?

A. Yes.

MR. WATSON: I assume, Mr. Philbin, you are going to follow that up by asking for the basis of his answer?

MR. PHILBIN: I do not know that there is any dispute about that. Is there?

MR. WATSON: Well, I just wanted to know what he is referring to.

MR. PHILBIN: I don't believe there is any dispute about it, your Honor, but we will refer to illustrations showing that these materials that this defendant uses have long been known in the yeast manufacture.

THE WITNESS: Referring to the Polsky British Patent 20,787, of 1892, which should be on page 6 of Defendant's Exhibit D-1, Polsky uses in the preparation of his mash the usual materials, grains and other materials, for the obtaining of his nitrogen. He then refers to the use of tartaric acid, and bicarbonate of soda, and carbonate of potash. He also refers to the use of carbonate of ammonia, and sal ammoniac. These are all introduced into the mixture. Carbonate of ammonia and sal ammoniac are inorganic ammonium salts.

Q. 81. Turn next to the Fritsche Austrian Patent 45/4047 of 1895 on page 36, and tell us what materials that patent discloses as being useful in yeast manufacture?

A. The Fritsche patent describes the use of ammonium salts, particularly ammonium phosfate, and states that they serve as nutrients for the yeast cells, and when added to the pressed yeast mash, bring about

a considerable multiplication of the yeast cells. So that they serve as a nutrient solution. Ammonium sulfate is given as an example of such ammonium salts. Ammonium sulfate is an inorganic ammonium salt.

Q. 83. What is used in this process or mash in addition to ammonium salts as nutrients for the yeast?

A. All of the material which is in the grains, of course, adds to the nutrient solution. In other words, this is a grain—inorganic ammonium salt mash.

Jacquemin British patent, 21,011 of 1896 specifies in addition to the fermentable sugars to be employed other materials or ingredients useful for the fermentation, malto-peptone, phosfate of ammonia, etc. Phosfate of ammonia is an inorganic ammonium salt. He gets his sugars from the grains, the starch from the grains. On page 1, line 10, of the provisional specification I see there is molasses quoted.

Mohlant British Patent 11,617 of 1913 in specifying a suitable liquid in which to so nourish the yeast, among other things, he refers to tartaric acid and nitrate of ammonium, phosphate of ammonium and carbonate of potassium, carbonate of magnesium and sulfate of ammonia. This patent refers to the growth of the seed yeast.

Q. 92. What is the difference between seed yeast and the yeast which is grown in the propagating vat or fermenter?

A. It is exactly the same yeast. The yeast in the fermenter is a growth from the seed yeast, the only difference being that in the growth of seed yeast you generally exercise a little more care against infection.

Roth French Patent 470,925 (1914) refers to the use of vinasse, nutritive and other salts as being applicable to the production of wort for the fermenters and he states specifically in making use of the mineral acids the purified molasses is introduced directly into

the fermenting vat and the molasses is purified through the use of the nutritive salts which are added at the same time. After the solution has become clear it is again mixed in the vat with nitrogenous extracts and nutritive salts.

On page 4 of this patent, after he has discussed using molasses and preparing it properly, it is stated: "When one has recourse to the formation of lactic acid, the molasses solution purified in accordance with the new process, is treated with nitrogenous clear extracts such as vinasse, nutritive or other salts, after having added thereto a powerful lactic acid ferment in the form of clear must. Acidification is allowed to proceed for some hours, after which it is run off into the fermentation vat."

I understand that is a preliminary step in preparing the molasses. Must is a material which is recovered from fermentation; it is a sort of muck, it has certain values in the nutrient solution.

Then the patent continues, after describing this preliminary step: "When one makes use of mineral acids exclusively, the purified molasses is placed directly into the fermentation vat and is made to ferment with clear nitrogen extracts, vinasse, nutritive salts, etc." I understand that to mean that this use of nutritive salts may also be in the fermenter if desired.

Turning now to the Lavedan Patent U. S. 1,201,062, application filed February 12, 1916, and patented October 10, 1916, it being the first patent in defendant's book of references, he refers to the use of grain and also to the use of molasses. The molasses when used is boiled with sulfuric acid for purposes which are well known and in the propagation of the yeast in the fermenter there are added the necessary nutritive salts which are potassium sulfate, ammonium phosfate, etc., and these are added in the amounts as needed.

On page 1, line 78 and following, of this patent it is stated: "In this propagation tank are added the necessary nutritive salts, such as potassium sulfate, ammonium phosfate, etc., in the amounts needed." Ammonium phosfate is an inorganic ammonium salt.

MR. PHILBIN: Those, may it please the court, are the references or prior art which we consider applicable to the first Hayduck patent in suit. Some of them, as your Honor will observe, do not say anything about neutralizing, for example, this last patent, but it is our position that there is no neutralization in defendant's process but that we merely use the same materials, molasses, grains and nutritive salts, which were old long before Hayduck. Some of the other patents we do consider squarely meet the neutralization idea of that first Hayduck patent.

THE COURT: These patents were all before Judge Soper, were they not, and all these articles which you set forth? Does he not refer to them in this opinion of his in the Federal Yeast case, 8 Fed. (2d) 186? I have glanced at that opinion as the witnesses testified. I wondered whether all the patents you set forth here as the prior state of the art were referred to by Judge Soper. Do you know?

MR. PHILBIN: We will give your Honor a list first of what was referred to by Judge Soper in his opinion; second, what was before Judge Soper; and, third, what was cited by the defendant during the case, and we will do that with respect to each of the patents and publications referred to by the defendant.

MR. WATSON: That will probably relieve us of offering certified copy of defendant's answer in

the Judge Soper case, which we did offer and which was objected to. But in view of Mr. Philbin's statement that the references just called to the attention of the witness represent his art applicable to the first patent in suit, it is necessary to point out that the Jacquemin reference has not been pleaded against this patent, in fact, it was not pleaded against any of the Hayduck patents, pleaded only against the fifth patent in suit, the Corby and Bührig. Now, if the Court please, that is very much of a surprise, to have them bring in that reference against '103.

Mr. Philbin: It is offered as the state of the art, your Honor, showing merely, as other references do, that molasses and grains, and ammonium salts, were commonly known to be yeast foods. It is not necessary, as I understand the law, to plead specifically——

Mr. Watson: That is all right, I will concede that it may go in as the state of the art, but I want it understood.

Mr. Philbin: The references which I will now ask the witness to consider relate, in our opinion, to the second patent in suit, the so-called '105, or regulated-feeding patent.

The Court: The gist of that patent is that it discloses a regulated feeding; is that correct?

Mr. Philbin: Yes, your Honor, so as not to get too much alcohol and to increase the yield of yeast.

Q. 99. Refer to the Iwanowski article, Journal of Society of Chemical Industry, 1903, which should be at page 40 of Defendant's Exhibit D-1, and tell us what this article means with respect to conditions under

which alcohol is produced, and conditions under which sugar is produced, in yeast growth?

A. The author refers to the fact that the higher the concentration of sugar in the nutrient solution, the stronger is the alcoholic ferment, and he refers specifically to the percentage of sugar which is desirable. In other words, he says if you have too much sugar, or sugar above a certain amount in concentration, you will get alcohol.

Q. 102. So that the amount of sugar or the dilution or the concentration of sugar was known to be important with respect to production of alcohol?

MR. JOHNSON: I think we should object to that as leading.

THE COURT: Well, I suppose the situation is the same as in the fermenting of wines, that the sugar is turned into alcohol in the process of fermentation?

THE WITNESS: The situation is a little different in this article, sir. The presence of the percentage of sugar above a certain amount will lead to the production of alcohol by the yeast. Therefore, it is desirable to keep the sugar solution low, the quantity of sugar low, in order that the yeast will be produced, and little alcohol will be produced. An excess of sugar in a solution is excess, means excess, when it produces a greater quantity of alcohol.

Q. 103. Now, when you are trying to make alcohol and get a large return of alcohol, what do you do about the sugar?

A. Well, the situation is entirely different. Then a large amount of sugar is desired, in the making of alcohol, as most of us know.

THE COURT: Yes, we found that out during Prohibition.

THE WITNESS: Turning now to the Rainer German Patent 10,135 of 1879, which should be at page 17 of Defendant's Exhibit D-1, Rainer refers to the growth of yeast in sugar solutions, made both by grains and also from other sugar sources, and he also refers to the use of mineral acids, these acids being of a number of varieties which were commonly known to the art at that time. He speaks of peptones. A peptone is a protein which has been acted upon so as to break it up into simpler compounds and make it available as a food. It is a thing which happens in our stomach. As we digest proteins, the action of the acids of the stomach breaks the proteins up into the simple elements which are available for food. The peptones may supply principally to the yeast, nitrogenous material, nitrogen. On page 8 of the translation I find the following disclosure or statement in the claim 2:

"The successive admission of peptones and carbohydrates into the relatively stable nutrient solution intended for yeast culture, and likewise, the successive withdrawal of the finished yeast, both in the proportions stated." Carbohydrates are sugars.

The first part of this patent, up to page 6, describes what kind of materials he uses and gives an example of the proportions of those materials—that is, peptones and sugars. He quite clearly describes the peptone content of the mash and also the carbohydrate content of the mash.

Q. 109. Then on page 6 it is stated, "When after a period of from six to eight hours the added dextrose or other variety of sugar has been consumed entirely or at least the greatest part thereof for the growth of the yeast, an additional portion containing from 1/20 to 1/10 per cent. is added and likewise the peptones after having been consumed can be added again to the liquor, either in portions or in a slow and continuous

stream, so that the same nutrient solution can with successive replacement of the consumed substance remain in use for entire weeks or months, unless it has been contaminated by other substances or secondary ferments and thus made unfit for further use."

What does that mean in even simpler language?

A. In very simple language, this article teaches that according to the demands of yeast growth, in order to obtain the optimum conditions, one would add sugar at varying times, or as stated clearly here, in a slow and continuous stream, as the sugar requirements of the mash require, and one would also add the peptones either in portions or in slow continuous stream; so that the patent teaches the method by which one may replenish the food requirements of the mash as the yeast consumes this food and also in a manner which will tend toward the optimum growth of the yeast.

Q. 110. The patent refers at this point to the condition that with successive replacements you can keep on using the same nutrient solution for entire weeks or months. Is that in your experience a practice that is employed commercially today, that is, keep on using the same thing over and over again?

A. No, one would not try to keep these things for so long because there is this danger of contamination which he points out. That is, as a practical commercial proposition it is too much trouble and costs too much to keep this solution free from ferments if you keep it going too long.

Q. 112. Then continuing, the article says: "in proportion as the materials required for yeast culture are added in portions, the yeast produced likewise is withdrawn successively and only the yeast which is still suspended in the liquor itself remains behind as seed for the alcoholic ferments still to be formed."

What would be the materials which you would require for yeast culture and which are to be added "in portions"?

A. The peptones and the carbohydrates, both would be required to be added.

Q. 113. Then at the bottom of that same page there is given another example of adding these foods, peptones and sugars or carbohydrates and following that there is a statement, "According to results obtained up to the present time, from 250 to 300 Kg. of the pure and vigorous pressed yeast can be obtained from every 100 kg. of pure peptone (dry weight), only about 200 kg. of dextrose or sugar being required for its cultivation."

THE WITNESS: Kg. means kilogram. Dextrose is a form of sugar, it is a more available form than the plain sucrose.

Q. 115. The patent states at the bottom of page 5: "The peptone content of the mash may amount to 1 to 2 per cent. of the weight thereof, and even more, whereas in each instance only ½ to 1 per cent. of dextrose or other carbohydrate shall be added in order to suppress lactic acid or alcoholic fermentation with certainty, and thus also to avoid any losses in my process caused thereby."

Will you tell us why this small addition of "dextrose or other carbohydrate" should suppress alcoholic fermentation?

A. It is a matter of experience. When the content of the carbohydrate, that is, the sugar content of the solution, is low, then there is a minimum of alcohol forming fermentation. That is what the author referred to, as I understand it, in this specification.

Q. 116. It is stated also an page 4 the following: "When a greater amount of carbohydrates is added, losses are very apt to ensue due to the fact that the

varieties of sugar used are partly converted into lactic acid or undergo alcoholic fermentation instead of merely supplying the cellular substance of the yeast."

What do you understand to be meant as to losses, losses in what, if you get this alcoholic fermentation?

A. Losses in food value when you convert the carbohydrates into yeast you have a greater yeast yield naturally than when you convert only part into yeast and the other part into alcohol.

THE WITNESS: As to the Delbruck article, Wochenschrift fur Brauerei. That article discusses, both quantitatively and in principle the production of alcohol instead of yeast in a sugar solution. On page 3 of the article there is the following: "The number of cells (yeast) increases with the proportion of available nutriment, but only as long as multiplication is not prevented through the accumulation of alcohol. As a rule, 4 per cent. of alcohol by weight suffices to put a limit to multiplication. Worts and mashes of a concentration which permits of exceeding this alcohol content, do not give the yeast multiplication corresponding to their nutrient content. To obtain the highest number of cells this alcohol content must not even approximately be formed during the fermentation."

That is a correct statement.

Q. 118. After describing preparation of a mash it is stated: "The highest crop (yeast) therefore is obtained by the continuous process of fermentation according to which there is first placed into a large fermentation vat the innoculating yeast together with a little wort, whereupon a stream of fresh nutrient liquid is run in continuously, distributed over, say 24 hours, until the receptacle is full."

What do you understand to be meant by the statement that in this continuous fermentation process in which there is a very little alcohol formed it is commenced with "a little wort"?

A. The teaching, it seems to me, is quite clear. A little wort in this large fermenting vat would result in a low sugar content. As the sugar is being consumed by the yeast, more sugar is to be added, but still kept at a low content; and in order to supply the sugar which is being consumed, in order to maintain a week solution of sugar in the vat, there is fed a stream of this nutrient liquor continuously in order to provide the optimum conditions of yeast growth which is with little alcohol, which is a solution of low sugar content.

Q. 119. And the amount of sugar fed in should always be such that under the conditions no alcohol should be formed?

A. Yes. He summarizes there what he has disclosed in the previous pages of his article.

THE WITNESS: Referring finally to the Lafar book entitled Handbuch der "Technischen Mykologie." This describes a method of fermenting molasses. It refers to a process which was used in employing molasses termed "drauflassen." Drauflassen means to add to.

Q. 123. In this process is the molasses added all at once, that is at the beginning in a batch method, or is it added from time to time as it may be required?

A. Well, the specification that he refers to is to have a dilution of molasses, and then the thick molasses is added gradually in the amount that the sugar has disappeared. I understand this process, as described, as using molasses principally if not wholly for the manufacture of alcohol and not yeast.

Q. 126. On page 3 it is stated: "Here also the ingenious practical man, by many trials, has discerned a way out; he arranges such a dilution of the molasses to be fermented as is known by experience to let the fermentation go on readily, and then adds thick molasses gradually, in the amount of sugar that has disappeared."

Why is it desirable to start out with a little molasses first and then add thicker molasses as the process of fermentation with yeast goes on?

A. A little molasses means little sugar, therefore dilution of the molasses means a dilution of the sugar content of the desired amount. The thick molasses is used because you can store more conveniently a thick syrup than you can a large amount of dilute substance, and the thick molasses is supplied, as stated, in the amounts required by the mash.

MR. PHILBIN: That, may it please the Court, terminates the references upon which the defendant will rely with respect to the second patent in suit. That patent was not before the Court of Appeals but was before Judge Soper in the District Court, and we will similarly give to your Honor a statement of what was before Judge Soper in considering that patent.

THE COURT: Well, if it was before Judge Soper why wasn't it before the Circuit Court of Appeals? Because the appeal didn't go up on the point covered?

MR. PHILBIN: There were two suits. In the first suit, there was involved only the '103 patent of those that are here in suit, and that did go to the Court of Appeals.

In the second case, the '105 patent was involved, and that did not go to the Court of Appeals.

MR. WATSON: And '106?

MR. PHILBIN: And '106.

THE COURT: Now you are proceeding with '106, are you. Well, I have fastened that in my mind by a note to the effect that it discloses two things: A regulated feeding program and neutralization of acidity.

MR. PHILBIN: Yes, your Honor. The position of the defendant with respect to that patent is that it discloses nothing more than was in the first patent, '103, and in the second patent, there being, however, added together in one process those two steps, and the plaintiff may take, will probably take, the position that there was patentable invention in putting together those two steps. Judge Soper, with some hesitancy, thought that there might be. However, so far as the art is concerned, the prior art, all the references which are applicable against the first patent and the second patent seem to us equally applicable against the third patent. So we will not discuss any additional art with respect to that third patent. With respect——

THE COURT: In other words, you say it covers no more than is covered by the two preceding patents, by the '103 and the '105.

MR. PHILBIN: That is defendant's position, except, your Honor, as I stated, there is combined together in one process those two different ideas.

With respect to the '109 patent, it seems to us to add nothing substantial to——

THE COURT: I have this memorandum: Discloses regulated feeding as in '103, '105 and '106; and then in my own words, "Plus nitrogenous neutralizing agent."

MR. PHILBIN: That is my understanding of this, your Honor. It has those things plus a neutralizer, which is a nitrogenous material, so that they furnish nitrogen to the yeast. The first neutralizing patent did not claim or did not have an ammonia or nitrogenous material which was supplied during the propagation period, and that last patent covers that; so it seems to us that the art,

the prior-art references which are available against the first two patents meet that last patent if they meet the first two.

With respect to the fifth patent in suit, the Corby, et al., patent——

THE COURT: We have been calling that '735.

MR. PHILBIN: '735, the full number being 1,673,735, it was filed on August 16, 1924——

THE COURT: I am somewhat confused on that patent, but I have some notes that I have made here, and as I read them to you, will you correct me?

THE COURT: Well, I took it that the disclosures of this patent are similar to the disclosures in '105-'106, to which a further factor is added, that the process continues for a period of time and then it stops or is stopped, and an addition of a nutrient solution is then added, this being done to prevent crowding. A portion is drawn off of the combined solution and water is added. Is that substantially correct?

MR. PHILBIN: That is my understanding, your Honor, and I think I will read claim 1 of that patent which in substance is what your Honor has said: "A process of manufacturing yeast by propagation with aeration, which comprises suspending seed yeast in a non-toxic liquid, aerating the liquid——"

So far that is old in the art.

"—adding yeast nutrients to the liquid in regulated amounts during the propagating period——"

That is what the Hayduck regulated feeding patent does.

"—periodically withdrawing a portion of the yeast containing liquid, diluting the residue thereof and then continuing the propagation therein with addition of nutrients."

So that the gist of this patent, as I understand it, over Hayduck regulated feeding is periodically withdrawing a portion of the yeast and then diluting the main fermenter and starting over again.

DIRECT EXAMINATION BY MR. PHILBIN (Continued):

Q. 127. In connection with the idea of withdrawing the grown yeast from time to time and then adding some more nutrient solution, will you refer to the same Rainer Patent 10,135 and tell us what is meant by the statement on page 6 second paragraph as follows:

"In proportion as the materials required for yeast culture are added in portions, the yeast produced likewise is withdrawn successively and only the yeast which is still suspended in the liquor itself remains behind as seed for the alcoholic ferments still to be formed."

In connection also with the statement in the claim 2 of the patent:

"The successive admission of peptones and carbohydrates into the relatively stable nutrient solution intended for yeast culture, and likewise, the successive withdrawal of the finished yeast, both in the proportions stated."

What does that mean with respect to withdrawing yeast successively and adding additional nutrient solution?

MR. WATSON: If the Court please, that question seems to go against the fifth patent in suit, '735, and against that patent the defendant has not pleaded the Rainer patent on which the witness is questioned.

MR. PHILBIN: That Rainer patent should be pleaded against the Corby patent and I will ask that defendant's answer be amended accordingly.

THE COURT: Amendment allowed.

A. The portion which you quote in the disclosure of the patent in connection with the second patent claim means clearly that as the material required for yeast culture may be added from time to time; so also the yeast produced during the fermentation may also be withdrawn successively and that the proportions are such as to maintain an optimum condition of yeast growth. It is intended that there should be a minimum production of alcohol. That is to be accomplished according to the teachings of this patent by providing the correct proportions of the nutrient solution. That proportion is a small proportion of sugar content.

Q. 130. Refer next to the Jacquemin British Patent 21,011, to which you have already referred, and state what it discloses with respect to the idea of growing yeast in a vat and withdrawing it and putting it in another vat?

A. The last paragraph on page 1 of the provisional specification of the Jacquemin patent refers to the quantity of yeast taken from the receiver and says that as it is taken from the receiver it is "replaced by an equal quantity of sterilized wort from the sterilizer, and so on each three, four, five, or six hours, depending on the number of vats to be fermented."

This procedure is carried out.

MR. WATSON: The original one is not pleaded, I think.

Q. 131. Referring to the complete specification which follows the provisional specification I find there stated the following at page 3, line 15 and following: "The quantity of wort usually introduced is about a

hectolitre; the selected pure Yeast is introduced at the Thermometer opening, so that the interior of the vessel or receiver should be as little as possible in contact with the exterior atmosphere. The Thermometer is then replaced and the Yeast is aerated for the reviving fermentation; when this takes place and the fermentation is well in activity, this first Yeast is passed into another receiver C of a larger capacity, and sterilized wort from the sterilizer A is poured on this Yeast, which results in a new and very important multiplication of Yeast. These substances or materials are then aerated during about 12 hours, and a certain quantity is then drawn off by the cock P into a vat D standing on legs and which is then charged with wort. In this way, a third Yeast is obtained which as soon as made is directed according to the requirements of the manufacture into the fermentation vats E.

"The quantity of Yeast taken from the receiver C is replaced by an equal quantity of sterilized wort from the sterilizer A, and so on for each three, four, five, or six hours depending on the number of vats to be fermented during 24 hours or longer, and according to whether the Yeasts remain pure, or commence to be contaminated."

What do you understand that process is, simply?

A. I understand that process to be that which is described or referred to in the claim 2 as a successive withdrawal of yeast and at the same time——

THE COURT: Claim 2 of what patent?

A. Rainer 10,135.

Q. 132. By that do you mean that substantially the same process is described in the Jacquemin patent with respect to successive withdrawal as is described in the Rainer, including this claim 2 of Rainer?

A. I would say that it covers the same general principles of operation, which are a withdrawal of the

yeast and the dilution of the remaining solution by the addition of wort, dilution with respect to the quantity of yeast contained.

THE COURT: Of course, that is coupled with the admission of peptones and carbohydrates, isn't it, from claim 2?

THE WITNESS: The wort too.

THE COURT: The wort?

THE WITNESS: Yes, sir.

Q. 133. What are the peptones and carbohydrates in the Rainer process? Are they the yeast nutrients, the food for the yeast?

A. Yes, that is what is meant. The yeast nutrient solution is composed of peptones and carbohydrates.

Q. 134. Is the same true of the Jacquemin, that after he withdraws the yeast he puts into the fermenter from which that yeast has been withdrawn some more yeast nutrient and the propagation of the yeast continues?

A. Yes, he does; stating specifically that the sterilized wort from the sterilizer A is poured on this yeast, which remains in the fermenter.

MR. PHILBIN: Direct examination closed.

CROSS-EXAMINATION BY MR. WATSON:

XQ. 135. Dr. Rautenstrauch, what is the course of engineering that you teach at Columbia?

A. Industrial engineering.

XQ. 136. How long have you studied these prior-art patents and publications that you have described in your testimony? How long have you studied those in preparation for the testimony you have just given?

A. That would be very difficult to determine, sir, but I was brought into this case as you know, last week.

In preparation for my testimony with respect to the disclosures of these references I did not read the opinions of the District Court and of the Court of Appeals of the Fourth Circuit in the cases against the Federal Yeast Corporation.

I was with the Liberty Yeast Corporation three years from 1923 to 1926. I did not know the operations of that company before I went with them. Before I went with the Liberty Yeast Company in 1923 I had not had any practical experience in the yeast business. I had no acquaintance with the yeast art prior to 1923.

XQ. 143. Are we to understand from that that your references in direct examination to commercial yeast practices are all limited to these practices since 1923?

A. No, sir, no more than your knowledge of Napoleon's wars is limited to your lifetime.

XQ. 144. In other words, you are speaking of information of prior practices acquired through reading?

A. Through reading and experience, sir.

XQ. 146. Referring to Defendant's Exhibit 3, which is the yellow paper sheet, in your opinion is that illustrative of defendant's process in this case?

A. No, sir, because the process embodies more things than are designated on this sheet. Only in that sense the exhibit fails to indicate the defendant's process.

XQ. 148. You spoke of the pre-treatment of the mash materials and called it peptonization. Is that the operation commonly referred to as souring?

A. Yes.

XQ. 149. I understood you in I think more than one instance to say that that souring should not go too far. What did you mean by that?

A. The reference to going too far, of course, is its own explanation. Particularly a souring which goes too far is one which has an excess of acidity.

XQ. 150. In what sense do you use the word "acidity" in your answer?

A. In the sense in which it is ordinarily used.

XQ. 151. What is that? I am asking you what sense you use it in. Can you give me a more extended statement of what you mean by acidity?

A. I don't think I can give you a clearer idea of it.

XQ. 152. Well, do you mean titratable acidity?

A. It may mean either that—it depends upon how you measure it.

XQ. 152a. Do you mean that it might have too much lactic acid in it?

A. That might be the case.

XQ. 154. Well, I am asking, Dr. Rautenstrauch, as to how you want us to understand your testimony, when you said that acidity should not go too far.

A. I can't quite understand your meaning now. The question has gotten confused. Will you please repeat it?

XQ. 156. As I say, I understood you in your direct testimony to say that it was not desirable to have too much acidity in souring. Now I am asking you why you made that statement. What did you mean by acidity, too much acidity?

A. I don't recall my statement in regard to too much acidity in souring. If you will refer to it I can probably recollect what I did say in speaking of the souring.

XQ. 157. You spoke of lactic fermentation in the pre-treatment of the mash.

A. Will you refer, please, to the exact statement I made? I don't recall the connection.

XQ. 158. Well, I am sorry, Dr. Rautenstrauch, but the stenographer has not transcribed the minutes of

the morning session and I can't hold everything you said in exact terms and therefore I cannot quote it. I am trying to give you the substance of your testimony. If you think that I am misquoting you, you may feel entirely free to say so, because I don't want to misquote you.

A. I can't understand your question, sir. I am frank to say.

MR. PHILBIN: I must confess, your Honor, I have the same difficulty. He is asking about acidity, and as I understand it, how much acidity might be harmful.

THE COURT: And what amounts of acidity.

MR. PHILBIN: Yes. I should think that would depend on what the conditions were. Of course, too much is bad.

MR. WATSON: In the early part of the examination the witness was asked particularly in connection with Defendant's Exhibit 3 and what occurred in the grain tank. As I understood him, he said there was lactic fermentation and unless controlled it was likely to produce an overacidity.

XQ. 159. Now, what did you mean by overacidity in that operation?

A. Well, overacidity in that operation would be an acidity which would contribute undesirable effects in the wort as the yeast was being nourished in the subsequent operation.

I don't know how such overacidity would arise. The acid in that in lactic fermentation comes from the bacteria, from the operation of the bacteria in the mash. It is lactic acid. It is produced as a result of the bacteria. It comes from all the substances on which it acts, which are anything in the mash, the sugar would be part of it.

XQ. 166. Do you know whether yeast assimilates lactic acid in the fermenting vat while there is any substantial amount of sugar present?

A. I cannot answer that question, sir.

XQ. 167. Do you know then whether the lactic acid is any different from the alcohol in this respect?

A. The alcohol is not assimilated by the yeast according to the best information I have; the extent to which the lactic acid contributes to the assimilation of nitrogen and other materials will depend upon a number of factors but it is a food in a sense in which alcohol is not a food. It is a disputed question whether yeast will assimilate alcohol. Some of the very best authorities dispute it.

XQ. 169. Referring to the second patent in suit, Hayduck '105, will you please repeat again your understanding of the sentence beginning at line 90 of page 1?

A. The sentence reads as follows: "The quantity of the diluted wort which is originally available for the yeast is so chosen, for example, that the mean content of the entire wort employed would be 3° to 5° Balling." My understanding of that sentence is that when the yeast is set it is desirable that the content of the wort be such as is measured by the Balling scale of 3 degrees or 5 degrees, between that range.

XQ. 170. As I understand what you have just said, it is that you think the content of the wort in the fermenter at the start should be between 3 and 5 degrees Balling; is that your understanding of the sentence?

A. The sentence so reads: "The quantity of the diluted wort which is originally available for the yeast is so chosen that the mean content of the entire wort employed would be 3° or 5° Balling." Now the entire wort employed is to be between these degrees Balling. That, therefore, refers to the dilute wort which

is in the beginning of the wort, and that which is added throughout the whole series, bearing in mind that the degrees Balling in the fermenter will not only be affected by the wort which is added but also be affected by the sugars which are consumed by the yeast. If, for example, we should have a 5-degree Balling mash and no further additions would be made, the feeding of the yeast on the sugar in that mash would reduce the Balling, that is, it would reduce the sugar content of the mash. That is how the yeast grows. So that this teaching is that taking all of these factors into account, the Balling should be kept at between three and five during the entire process. That is my understanding of the operations.

XQ. 171. Do you think the word "mean" in the sentence means average?

A. Yes, sir.

XQ. 172. In the disclosure of this patent what is your understanding as to the initial Balling of the dilute portion in the fermenter?

A. The initial Balling is about 1 degree as stated in line 73, page 1.

XQ. 173. And it is also stated, is it not, that the Balling of the reserve wort to be fed in may be, for example, 12 degrees Balling?

A. That is correct, sir.

XQ. 174. What is your understanding of the final Balling of the wort in the fermenter?

A. I find no specification in regard to the final Balling. I therefore cannot answer your question.

XQ. 175. You cannot answer the question under your interpretation of the meaning of the sentence beginning at line 90?

A. Your question has no relation to the sentence beginning at line 90.

XQ. 176. Can you give an idea of the Balling in the fermenter at a middle portion of the propagating period?

A. Not from this, sir.

XQ. 177. Is it your opinion that that question also has no relation to the sentence beginning with line 90, page 1, or vice versa?

A. Well, it clearly states that the wort shall have a mean Balling of 3 degrees to 5 degrees during the propagation, and I understand that to mean that it is the average Balling most desired during the operation of the fermenter.

XQ. 178. What is your understanding as to the disclosure of the patent with respect to the Balling curve in the fermenter?

A. I have no understanding of what the disclosure of the patent is as to the Balling curve. There is no relationship brought out there which would indicate the Balling curve.

I did not hear the testimony of Dr. Lamb in this case with respect to the meaning of that sentence beginning in line 90. I have read Dr. Lamb's testimony.

XQ. 181. Then, are you expressing a disagreement with him on that point?

A. I would like to be reminded of what the testimony is. I can't bear in mind exactly what he said. May I read the testimony, please?

XQ. 182. Just a moment.

THE WITNESS (aside to the Court): You have clearly in mind, your Honor, that degree Balling refers to the sugar content?

THE COURT: Well, not entirely to sugar, does it, Doctor?

THE WITNESS: Generally.

THE COURT: It is just a measurement of the sugar content, is it?

THE WITNESS: Yes, generally.

THE COURT: In other words, the Balling scale is the sugar scale, is it?

THE WITNESS: Generally. If it is an entire sugar solution, then it is absolute. Where the sugar predominates, it approximates. So that when you refer to the Balling of the mash, you are interested in that reference to the amount of sugar. It shows it relatively.

THE COURT: And another word for the sugar is the carbohydrates?

THE WITNESS: That is right, which the yeast feeds on.

THE COURT: Aside from the record a moment, do you claim the exclusive right to use molasses in the manufacture? That is, molasses as the sole product from which the yeast is made?

MR. JOHNSON: No, your Honor.

THE COURT: That was known in the art prior to these patents, was it not? That is, that molasses could be used?

MR. JOHNSON: Attempts have been made to use it commercially in the manufacture of yeast.

THE COURT: But not as the sole product from which the yeast is made?

MR. JOHNSON: Both mixed in with the grains and as the sole source of sugar.

THE COURT: But owing to the lack of a processing formula it couldn't be done, is that it?

MR. JOHNSON: That is our position.

THE COURT: And do you take the position that your formula gives to you the exclusive right to manufacture yeast from molasses because it is the only process which can be applied to molasses with the desired result?

MR. JOHNSON: I shouldn't put it quite that way, your Honor.

THE COURT: How would you put it?

MR. JOHNSON: I think this inventor Hayduck discovered that molasses could be used with ammonium salts, provided the deleterious excess of acidity was neutralized, and he covers that particular phase of it in his '103 patent; then, in his '105, '106 and '109 patents he covers a regulated control of the addition of materials to get a higher yield.

THE COURT: Always contemplating the use of molasses as a base; is that it?

MR. JOHNSON: That is one of the sugar materials that he contemplates.

THE COURT: Well, in practice, is that what is used, molasses?

MR. JOHNSON: It is by Standard Brands, your Honor. It has been for a number of years, although——

THE COURT: Now, the Doctor here on the stand says that the Balling measurement deals entirely with sugar. In other words, it is used for the purpose of measuring the sugar content of the wort. Do you agree with that?

MR. JOHNSON: I think, your Honor, that the Balling scale is for a pure sugar solution, just like the temperature scale of Fahrenheit and Centigrade are named after certain individuals. I be-

lieve the witness will agree, however, that in the yeast-manufacturing industry the word "Balling" is not applied to pure sugar, but is the same spindle put down to determine the density of a solution which is not pure sugar but contains other solids.

Is that not correct?

THE WITNESS: Correct, but as I explained to you a moment ago, it is used relatively. The actual numbers have a different significance, but relatively they are useful.

XQ. 183. I refer you for example to the portion of Dr. Lamb's testimony beginning at the first full paragraph on page 64 and extending over to Q. 42 on page 65.

A. May I have a moment to read the question, please?

XQ. 184. Certainly, yes.

A. I have read the testimony of Dr. Lamb to which you refer and I see no reason to disagree with that testimony. May I add to that answer somewhat?

XQ. 185. Yes.

A. Because really what we are after is to see that the Judge understands it. I think——

THE COURT: He may have some difficulty.

A. (Continuing.) I think, your Honor, in the calculation for the Balling, considering the entire wort to be used, one has to be careful in getting a concept of what Balling is used in the entire mash, because of the fact that the yeast consumes sugar in the fermenter, and therefore one should not be able to calculate the average Balling that would be had if you took all the sugar solution and put it in a vat at one time, as an average; because as the sugar is being fed in, the

yeast also consumes sugar, and that also affects the Balling of the mash, just as much as the addition of the yeast affects the Balling of the mash.

By THE COURT:

Q. 186. How would that affect the Balling scale? Would the sugar that has been consumed and finds itself embodied in the yeast have any effect whatever upon the Balling measurement?

A. Not then, but there would be an effect on the Balling measurement due to a possible change in the density of the mash, due to the excretions of the yeast.

Q. 187. Or the nutrient?

A. That is it.

Q. 188. Or malt?

A. That is correct, sir.

Q. 189. There would be some sugar removed from the nutrient consumed by the yeast, which would affect the Balling scale?

A. Tend to lower the Balling scale.

Q. 190. Tend to lower it?

A. While the addition of wort of a high Balling tends to raise the Balling scale. So that if one is to compute the average Balling, that is to be had from a given amount of wort, one would have to take into account the rate at which the sugar is consumed by the yeast as well as what is added from the wort.

By MR. WATSON:

XQ. 191. Under your interpretation is it fair to say this, as your opinion, that if you start with a diluted wort of 1 degree Balling and feed in the reserve you must end with a Balling of 5 degrees or higher?

A. Oh, no, that has no relation at all to my answer; that could never be implied from my answer.

XQ. 192. I just want to make sure that——

A. Well, that is perfectly obvious.

XQ. 192. (Continuing.) —that we have a sufficient explanation to really understand what your opinion is on the subject.

Now, if we start with 1 degree Balling solution and we have a reserve of 12 degrees Balling, the quantity of the starting solution——

THE COURT: Just a moment, what do you mean by a reserve of 12?

MR. WATSON: The reserve, your Honor, is the more concentrated nutrient solution which is fed into the fermenter during the period of propagation and of course——

THE COURT: You start with one thing——

MR. WATSON: You start with a dilute portion in the tank——

THE COURT: One Balling in the tank?

MR. WATSON: In tank A.

THE COURT: Now you have 12 Balling on the side to feed in?

MR. WATSON: You have another tank of 12 Balling to feed into it. I am asking the witness if given the respective volumes he can calculate a mean Balling of the two.

A. Yes, one could calculate the mean Balling of the two just as a problem in arithmetic where you take the quantity of material that is of 12 Balling and the quantity of the material that is 1 Balling and by those quantities and percentages you can determine what is the average, that is, in relation to the average which may exist in the fermenter.

XQ. 193. That mathematical computation was correctly gone through by Dr. Lamb, was it? You have no criticism of his mathematics, in other words?

A. No, the arithmetic I should say is all right, but I think the Court should be clear on the point that that has no relation to the Balling that may be in the fermenter, due to the action of the yeast itself in affecting the Balling.

THE COURT: How would you measure it in the fermenter?

THE WITNESS: You will have to measure it by tests, sir, as you proceed, and that is the practical way in which it is done in yeast manufacture. You keep testing your Balling from time to time.

XQ. 194. Are you familiar with the defendant's processes, broadly speaking, to the extent of knowing their Ballings?

A. No.

While I was with the Liberty Company we always followed a process in which we fed a more concentrated reserve solution into a relatively dilute initial solution.

I couldn't tell you what was the Balling in our fermenter with that process. That is ten years ago. I couldn't tell you whether it was ever as high as 5. I couldn't tell you whether it was ever as high as 3.

XQ. 199. Can't you tell me without hesitation that it was not significantly above 2 degrees?

A. I have not the data, sir, and I cannot answer the question.

XQ. 200. In speaking of the Wilfert reference of 1890 is it your opinion that the lactic fermentation shown would ever provide an overacidity?

THE COURT: Let me say I don't understand what lactic fermentation is. Will one of you tell me?

THE WITNESS: Lactic fermentation, sir, is that fermentation which is produced by the lactic acid

bacteria which is introduced into the mash, and as a result of its action on the proteins in the mash it produces it.

THE COURT: What other kinds of fermentation are there other than lactic?

THE WITNESS: The fermentation term is used rather broadly in this art. We speak of fermentation in the fermenter when the yeast is being grown but the only fermentation that takes place in the sense in which lactic acid produces the fermentation, there is no other way in which that is used, I mean the lactic acid is the only kind of fermentation that takes place in that sense.

By MR. WATSON:

THE WITNESS: There are all kinds of alcoholic fermentations, but that is a different kind of fermentation. I mean resulting from a different organism. When we speak of fermentation in the fermenter and that alcohol is fermented, then we refer to the action of the yeast in producing alcohol and that is called a fermentation; that is a different kind of a fermentation than the lactic acid bacteria produced in the mash in which you peptonize your mash. For the moment I do not see any reference in Wilfert to the action that you refer to. If there is I would be very pleased to have you point it out to me.

XQ. 203. I will pass it for the moment. It was my understanding that you stated in your direct examination with respect to this reference that it disclosed undesirable acidity and you drew the conclusion, as I understood you, that in such a case it would be obvious to neutralize the excessive acidity; is that correct?

A. That is correct, sir.

XQ. 204. What kind of acidity were you speaking of as disclosed by this reference?

A. All the acidity which is produced by the lactic acid bacteria or by the sulfuric acid which is used in the molasses, so that both the acidities need to be corrected before utilization regardless of origin.

XQ. 205. How much sulfuric acid was used in the molasses according to this reference?

A. There is no specification other than that a small amount of sulfuric acid is highly beneficial.

The purpose of the addition of sulfuric acid was pretreatment and to purify the molasses before filtering and utilization.

XQ. 210. Just one or two more questions on that mean Balling, Dr. Rautenstrauch. Is it your understanding that under the disclosure of the sentence referred to, the maximum Balling in the fermenter at any time may be as high as 5 degrees?

A. That may be interpreted as that, yes.

XQ. 211. I am asking you if that is the way you interpret it?

A. I interpret it that that is a possibility.

XQ. 212. Considering the operation conducted with a diluted portion of a Balling of 1 per cent., and the reserve fed in to provide that maximum Balling of 5 degrees, what is your opinion as to whether that can be accomplished and at the same time have the reserve nutrient fed in only in accordance with the growth requirements of the yeast?

A. If I understand your question correctly, the accomplishment of that process is carried on by determining the degree of Balling in your mash from time to time. Is that the particular point that you are asking me about?

XQ. 213. The question is whether you can get that 5 degree Balling without as a consequence having fed in the nutrients faster than the nutrient substances can be most efficaciously and quickly assimilated by the yeast?

A. I don't think that those two situations have any relation to each other.

XQ. 214. Whether or not they do; can you answer that question?

A. Well, the question, frankly, doesn't make sense to me. I can't understand it. May I state what I think you mean?

XQ. 215. I will restate it. We are starting the operation with a dilute portion having a 1-degree Balling. And we are feeding a 12-degree reserve in at a rate such that the Balling in the fermenter rises to 5 degrees.

A. I don't accept the 5 degrees, sir. I said a moment ago that perchance there may be at some one time a 5-degree Balling, but I did not assume in that answer that it would remain at a 5-degree Balling.

XQ. 218. All right. Assume that it is a momentary condition, if you will; my question is now whether that procedure would not have been accompanied by a supply of yeast nutrients in the fermenter more rapidly than the yeast could assimilate?

A. Yes, if you had 5 per cent. the probabilities are that it would be in there in greater proportion than——

XQ. 219. Would that also apply if the in-feed rate was such that a maximum of 3 degrees Balling was obtained?

A. Not necessarily.

XQ. 220. In the case of a feed-in to arrive at the 5-degree Balling, do you know whether that operation would necessarily be accompanied with the formation of alcohol in the fermenter?

A. It all depends on the quantity of yeast which is present.

XQ. 221. Explain that further, if you will.

A. Well, in a mash in which there is a great deal of yeast present, you have an entirely different situation in regard to the relation between the Balling degree of saturation of the mash and the production of alcohol. So that, as you feed your wort, you tend to feed it to provide a Balling in the fermenter in accordance with the quantity of yeast which is present to consume your sugar and with the amount of aeration.

XQ. 223. Now, reverting to the Wilfert article, you have spoken of the acid as lactic acid and whatever acidity resulted from the slight amount of sulfuric added in the pre-treatment of the molasses. Taking such a wort in the fermenter, can you tell me whether during the period of propagation the acidity would remain constant or would tend to decrease over the propagating period, or would tend to increase?

A. The tendency is to increase the acidity during the propagation period.

That is to say, if we start with a mash soured and having lactic acid in it, that during the period of propagation of the yeast in the fermenter, the acidity tends to rise.

XQ. 225. At least that is your understanding of the operation, is it?

A. A very small amount. Are you talking of significant rise or——

XQ. 226. I am talking about any rise.

A. Yes, the records show that there is a slight rise. I mean records of experiments in the operation of the fermenters. Experiments that I have seen years ago when I was in the yeast business, ten years ago.

XQ. 230. And you remember those but you can't remember the Balling?

A. No, I can't remember the Balling.

XQ. 231. And the Balling measurement referred to commercial operations, didn't it, and not to experiments?

A. That is right, sir.

Referring to the Pollak reference, that shows a pre-treatment of the mash materials by lactic fermentation. And the use of ammonia to form ammonium lactate.

XQ. 234. You spoke of the action of the ammonia, I think, as a neutralizing action on the lactic acid, is that correct?

A. That is correct.

XQ. 235. And can you tell me the purpose in that reference of such neutralization?

A. In the Pollak case where ammonia is added to the first step in the process, the ammonia tends to neutralize the overacidity, and by overacidity I mean that acidity in which the lactic acid bacteria would tend to die. It keeps the acidity at a point which is favorable to the growth of the lactic acid. So that the ammonia in that step serves that particular purpose. In the second step, the ammonia serves the purpose of a nutrient, because the lactic acid itself in the second step has a certain buffering action.

XQ. 236. Now, referring to the neutralizing action of the ammonia on the lactic acid, is it not correct to say that Pollak's purpose was thereby to provide for the development of increased lactic acid?

A. I don't see how he could get an increased lactic acid by the addition of ammonia.

XQ. 237. His purpose was to build up a considerable quantity of ammonium lactate in the solution, was it not?

A. It served that purpose, yes.

XQ. 238. That was his express aim, was it not?

A. Not the only aim; the aim was to neutralize so that the lactic acid bacteria would not die off in the process. That was the neutralization.

XQ. 239. And as a result of not dying off would be free to continue the development of additional lactic acid?

A. That is correct, yes, sir.

XQ. 240. Referring to the article by Brenner in the Centralblatt in 1914 you spoke of the mold fungi. Do you know whether those are desirable or undesirable in yeast manufacture?

A. Fungi are very undesirable in yeast manufacture, sir.

I never read that entire article by Brenner from which we have two pages here. I do not know how long it is.

XQ. 244. In your opinion is there anything of significance in the abstract appearing in the "Journal of the Society of Chemical Industries," the article by Henneberg, which does not appear in the Pure Products article of 1908?

A. My opinion is that the Pure Products article and the review which you refer to were taken from the same source. I would say that the Pure Products article is a more amplified restatement of the original German by Henneberg.

XQ. 246. What I am getting at, Dr. Rautenstrauch, is to see whether we cannot fairly simplify our task by disregarding the short abstract and considering the Pure Products article.

A. Well, I don't know what task you refer to.

XQ. 247. Is there anything of significance in the short abstract of the Journal which is not also in the Pure Products article?

A. Well, I think the significance is that it had importance to a wide range of readers and was rather widely quoted, I think that is the significance.

XQ. 248. I speak of the disclosure, excuse me.

A. Oh, the disclosure, I beg your pardon. I should say that the disclosure in the Pure Products article

was quite similar to that which was in the condensed article. They are the same in my opinion.

XQ. 250. Did you ever read the original or a translation of the original article by Henneberg in the Wochenschrift of which these both are abstracts or paraphrases?

A. I may have but I have talked with Henneberg about this in his laboratories in Kiel.

MR. WATSON: I guess we won't go into that, will we, Mr. Philbin?

MR. PHILBIN: I think that is unnecessary but I do wish to object to a characterization of the Pure Products magazine and the abstract as so-called, merely restatements of what was in the Henneberg article. They are what they purport to be, the conclusions and the descriptions of certain people who read that article and it is what they meant to these people and were published by these people. They may or may not have any relation to the Henneberg article. We are relying on these publications as disclosures.

XQ. 251. You expressed the opinion that conclusion 4 on the first page of the Pure Products magazine was correct. In your opinion is the third conclusion also correct?

A. I think it is, sir.

XQ. 252. Hydrant water is what is familiarly known as tap water, is it not?

A. That is correct. And tap water, of course, may be used in yeast manufacture in large quantities. You have a well from which you draw your water as a rule and tap water is the water you get out of the faucet.

THE COURT: In other words, you have a water, the analysis of which would remain constant, is that it, usually so?

THE WITNESS: Practically, yes.

XQ. 255. In both cases it is natural water as distinguished from distilled water?

A. That is correct, sir.

XQ. 256. Referring to the fourth conclusion, do you know what the words "other salts" refer to?

A. They may mean quite a wide range but I think they include the ammonia salts. They may include calcium sulfate.

MR. PHILBIN: I assume the question means what those words "other salts" mean as used in this particular article.

MR. WATSON: That is correct.

XQ. 258. By the way, while I look up another reference here, may I ask you whether you recall now the commercial operations of the Liberty Company, whether you obtained any substantial amount of alcohol as a by-product?

A. We did not. Not in the yeast manufacture.

XQ. 260-1. As I understood your direct examination, you did not express the opinion that the Polsky referenee or the Fritsche or the Jacquemin reference or the Molhant reference or the Roth reference or the Lavedan reference disclosed any yeast manufacturing process which included the use of inorganic ammonium salts plus the use of the neutralizing agent to prevent the occurrence of deleterious acidity arising from those salts. Was I correct in that understanding?

MR. PHILBIN: To save time, your Honor, I am entirely willing to accept Mr. Watson's statement, subject to correction. I don't recall any reference by the witness to the use of any neutralizing agent such as ammonia or the things we have been talking about, in connection with any of these references. I don't recall the witness so testified. I

think we can accept Mr. Watson's statement subject to correction.

MR. WATSON: That is entirely satisfactory to me, if the Court please. I think Mr. Philbin and I are in agreement in understanding what the witness said.

XQ. 264. Referring to the abstract of the Iwanowski article, may I ask you whether you ever read that article in full, of which this is an abstract?

A. No, sir.

XQ. 265. Is the significance of that abstract, in your opinion, the disclosure of a tendency toward increased alcohol production in the presence of increased sugar concentration, and the obtainment of low alcohol yields in the case of low sugar concentration?

A. That is emphasized in the article and that is substantially what it refers to.

XQ. 266. You stated that you do have some knowledge of yeast manufacture prior to your direct contact with the industry in 1923. Do you know——

A. I didn't have any experience with the yeast manufacture before 1923.

XQ. 267. I understand that, but I also understood that you claimed to have some knowledge of how yeast was made before that time.

A. Yes; through subsequently acquired knowledge.

XQ. 270. Do you know how bakers' yeast was made about the date of the Iwanowski article in 1903?

A. Only to the extent that in 1903, about that period, the products of yeast and alcohol were both desirable, and there was not the attention given to alcohol fermentation that there was in later years, especially when Prohibition was enacted in this country, and when in Germany yeast had to be grown very largely as a food.

XQ. 271. Well, we will come to that later, but I am asking you about 1903.

A. Well, the specific condition surrounding yeast manufacture at that time was that the alcohol content——

XQ. 272. I am not really yet inquiring, Dr. Rautenstrauch, about any reasons for practice. First I want to get the practice.

A. Well, that was the most practical thing, because that affected the income.

XQ. 273. What was the practical thing?

A. To get a product which would——

XQ. 274. Well, how did they do it?

MR. PHILBIN: I think he ought to be allowed to answer the question.

THE COURT: Well, Doctor, the product produced both alcohol and yeast.

THE WITNESS: Yes.

THE COURT: They being equally valuable for certain purposes.

THE WITNESS: Exactly.

XQ. 275. All right. How was that process conducted?

A. They conducted it very largely with grain, mashes, and proceeded to let their yeast grow with the usual methods known at that time, with a certain amount of sugar and——

XQ. 276. That was what is commonly known as a straight-set mash, was it not?

A. That is right, straight-set mash.

I do not recall the Balling of those mashes which was commonly employed. I know it was a relatively high Balling compared to more recent practice. I wouldn't say the Balling was 12 or 15 degrees, but it was high. I wouldn't say it was not that high.

XQ. 281. Referring to the Rainer German patent, do you know in general the process commercially em-

ployed in manufacturing bakers' yeast about that date, 1879?

A. It wasn't very different than the straight mash, straight-set mash.

XQ. 282. And, as far as you know, was the commercial practice in 1879 about the same at all times until 1923?

A. Well, I couldn't say that from knowing how all yeast plants worked, but in general I should say there wasn't very much improvement. That was all straight-set mash operation and all higher Balling wort than was practiced later. And all included the production of yeast and the simultaneous production of alcohol.

XQ. 287. You referred to Claim 2 of the Rainer patent. The process as recited there contemplated something of a perpetual motion scheme, did it not, in which at intervals you put in nutrient materials, and at other intervals drew off yeast, and that sequence continued ad infinitum?

A. No, I wouldn't say that that was any more perpetual motion than anything else which is a series of operations of this kind.

XQ. 288. Well, the patent discloses, does it not, the continuation of that sequence over long intervals of time?

A. The intervals of time are quite clearly referred to in the disclosure; 6 to 8 hours and other hours are mentioned, 12 to 15 hours—the usual times required for yeast propagation.

XQ. 289. Well, that is for each crop, but considering the continuance with the same fermenter and contents, it is my recollection that this reference speaks of operations continuing over a period of weeks and months.

A. Not necessarily because one in making a practical application would naturally use his common sense

and good judgment in allowing the operation to be carried out.

XQ. 290. Well, I can understand your opinion on that, but I am speaking first of the disclosure of the document and what the document itself says.

A. Yes. Well, the document——

XQ. 291. Have you overlooked that reference to continuance over weeks and months?

A. No, I haven't overlooked it, but in all these disclosures one must bear in mind that the disclosure is made with reference to what is common practice in the art, and naturally when it is common practice to cease a fermentation in order to prevent infection, that would naturally not be repeated in the disclosure. It is accepted in the light of what is common practice in the art.

XQ. 292. I understood your direct examination also to include the statement that the duration of this process would be terminated in practice on account of the danger of infection and that was the only reason I understood you to advance for that termination.

A. That may have been the only reason which I thought was pertinent to the question.

XQ. 293. Well, now, I am asking you if there are other reasons why that recommended procedure would not in practice be followed.

A. Well, for example, you wouldn't want to store that kind of material about the place, it is more convenient to have it in its raw state for handling purposes.

XQ. 294. What material are you speaking of now?

A. The material out of which the wort is made.

XQ. 295. What is that?

A. All the materials which were referred to here, grain, molasses and so on.

XQ. 296. Are you referring to the peptone extract?

A. Yes.

XQ. 297. And you say that the undesirability of having to store the peptone extract would prevent one in practice from carrying out the recommended procedure of using the same fermenter and contents over weeks and months, is that correct?

A. That might be a deterrent, yes.

XQ. 298. I don't just follow that logic. How would the continuance of the operation over weeks or months or its interruption in the discarding of the solution at intervals be affected by the storage of the peptone extract?

A. That wouldn't affect it but from the practical operation of the plant, from the cost of production, costs entailed in keeping solution like that about the plant in large vats, all those factors are taken into account.

XQ. 299. What solution are you referring to?

A. Peptones and carbohydrates.

XQ. 300. Peptone extract?

A. Yes.

XQ. 301. Is it your understanding that the reference discloses the use of a peptone material in solution?

A. Well, peptone material is always in solution.

XQ. 302. Never dry?

A. Before it is put in solution it is dry, yes. I would take the peptone solution which is added to the mash to be added in a solution form and not dry form as a practical matter.

XQ. 303. Well, if it is going to be added in a solution form, then I take it that another reason why one would not practically follow this indefinite operation in the same fermenter is because the fermenter would have to be infinitely large, is that correct?

A. If you brought it over an infinite length of time with a given quantity of material, naturally the arith-

metic would mean there would be an infinitely large fermenter but I don't think that nonsense was intended in this disclosure.

XQ. 304. That is one reason why you say the practical man would not follow his instructions?

A. Oh, no, I don't say that. I must be frank to confess I don't know whether you and I are talking about the same thing, I don't understand your questions clearly.

XQ. 305. Well, if you have any uncertainties I would request you to ask me to clear them because I don't want any misunderstanding between us.

Do you know whether the recommendation of this patent to use ozone or ozonized air has ever been followed in practice?

A. I don't know of any practical application of that, sir.

XQ. 306. Or the use of hydrogen peroxide?

A. Which accomplishes the same thing; no, sir.

It is my understanding that this Rainer patent discloses down to the beginning of the third paragraph preceding the claims one procedure and in that third paragraph preceding the claims discloses a second or an alternative procedure.

XQ. 308. As you read the patent does it indicate any preference as between those two procedures?

A. Only as the second procedure suggests that it would result in the production of a more pure yeast and one which is free from secondary ferments.

XQ. 309. I understood you to say on direct examination that Rainer disclosed the addition of dextrose or other kind of sugar by a slow and continuous stream. Is my understanding correct?

A. That is correct, sir.

XQ. 310. Where did you find that in the reference?

A. I find that in the reference on page 6 of the translation.

XQ. 311. I think you had better give us the first few words of the paragraph so that we can identify it; our translations do not always coincide on page numbers.

A. I will give the paragraph and my reason for my interpretation. The paragraph reads as follows: "When after a period of from 6 to 8 hours the added dextrose or other variety of sugar has been consumed entirely or at least the greatest part thereof for the growth of the yeast, an additional portion containing from 1/20 to 1/10% is added and likewise——"

XQ. 312. Colon.

A. There is no colon in this translation.

XQ. 313. It will be helpful if you can include in your reading the commas and periods, etc.

A. Well, there is no colon at this part, sir. Am I correct in that?

XQ. 314. I think not but I haven't the German before me so I cannot say. Just quote it into the record as you have it before you.

A. "—and likewise the peptones after having been consumed can be added again to the liquor—comma—either in portions or in a slow and continuous stream." I understand that as a practical matter one would interpret "likewise" to refer not only to the dextrose additions but to the peptone additions, and to my mind the paragraph fairly teaches that one may add sugar solutions, dextrose, and likewise peptones in portions or in a slow and continuous stream.

MR. PHILBIN: May I correct the translation, your Honor, by putting a comma after "likewise" because the German text does have a comma?

MR. WATSON: Not after "likewise."

THE COURT: What about that semicolon you were looking for?

MR. WATSON: Colon—we aren't right just yet, it is a comma.

MR. PHILBIN: I have here the German.

(Handed to the Court.)

Have you decided where the comma is?

THE WITNESS: My interpretation of the comma, sir, is that it occurs after the "and" and before the "likewise."

XQ. 315. In your direct examination you were questioned as to the final paragraph of the specification. In your consideration of the disclosure of this Rainer patent, did you, in the light of that paragraph and of the balance of the specification, ever calculate Rainer's yield of yeast on his raw materials employed?

A. No, nor can it be done. And may I explain why not, sir?

XQ. 316. Yes, indeed.

A. You will find in the disclosures of the Rainer patent, that he refers to successive additions of peptones and dextrose. These are specified when added to be between certain percentages of the total materials. One cannot determine from these disclosures how many times during the fermentation to which the figures in the last paragraph refer, how many times during the fermentation these additions were made. So that one has no right to assume that only one addition has been made in the case of sugar or one addition in the case of peptones, because the teaching is quite clear that peptones may be renewed and sugar may be renewed as required. So that there is not sufficient information in the disclosure to check up the values given in the last paragraph referred to where he says that the quantity of pure yeast obtained is

from 250 to 300 kilograms, and this quantity is obtained from every 100 kilograms of pure peptone and 200 kilograms of dextrose.

XQ. 317. Can you make the calculation, did you ever do so, of how much of the cereals or industrial refuse and such referred to in the specification would be required to make up 100 kilograms of pure peptone by weight, as referred to in this Rainer specification?

A. No; I can't make such calculation. There is not sufficient data in the specification to make that calculation, in the first place. In the second place, I am not accustomed to making calculations of that kind. I haven't made a calculation like that for a long time.

XQ. 319. I am raising no point about it except I want to know about the disclosure of the specification. And it is true, is it not, that the specification gives illustrative typical starting materials and procedure to obtain his pure peptone, what he calls his pure peptone?

A. Yes. That is correct. But it is also true that he doesn't state how many times he does it.

XQ. 320. Does what?

A. He does the feeding, how many times he puts in the peptone and how many times he puts in the sugar. And for that reason, to my mind, he adds this last paragraph, to sum up the whole thing, to show just what was the final result.

XQ. 322. Well, I am not sure from your last statement that I understand your reason for believing the last paragraph ambiguous. Is it because you think that the nutrient solution in the fermenter from which this yeast is produced contained an unknown quantity of unassimilated sugar or peptone extract?

A. I don't accept your characterization that it is ambiguous. I think it is very definite. I think the author very clearly states that he gets from 250 to 300

kilograms of pure compressed yeast from 100 kilograms of pure peptone and 200 kilograms of dextrose. So that measuring it in terms of dextrose, as it is frequently done, one would say that he would get 125 per cent. yield on the basis of sugar, 125 per cent. to 150 per cent. yield on the sugar basis; and I think that gives a very clear, definite statement.

By THE COURT:

Q. 324. That means as to weight. Does that mean as to weight?

A. Yes, sir.

Q. 325. In other words, if you put in 100 pounds by weight, it would bring out 125?

A. Yes, because the additional weight comes from the peptones which are absorbed.

Q. 326. What would be the total?

A. The total, sir, would be 100 per cent., and less than 100 per cent. That is, 100 kilograms of peptones and 200 kilograms of dextrose.

Q. 327. Of the materials that are put in to make the yeast, what percentage would be converted into yeast?

A. He claims that it would be 100 per cent.——

Q. 328. By weight, by weight?

A. Yes, 100 per cent. and less. It would be 100 per cent. to 84 per cent.—84 to 100 per cent.

Q. 329. One of the witnesses testifying here, as I understand it, said that in a certain process 80 per cent. of the gross materials put in was taken out in the form of yeast. Now, do I understand you to say that the entire gross content put in by weight comes out in yeast?

A. Yes, of the dry weight of peptone and sugar and——

Q. 330. Of nothing else, out of all the materials put into the wort and yeast?

A. There is also water put in, sir.

XQ. 350. In the litigation between the present plaintiff and the Federal Yeast Corporation on Patent '105, the expert for the defendant testified that he had conducted experiments following Rainer, and testified that he had selected malt sprouts as best suited to give the peptone, and further testified that 1400 units of the malt sprouts were required to give 100 units of the peptone on the dry-weight basis. In your opinion, is that ratio of 1400 to 100 reasonably correct and to be expected?

A. I have no opinion on the matter, sir. Considering the disclosure of this Rainer reference, there is no disclosure as to the peptone and the sugar ratio of the wort, at any one particular time in the mash.

XQ. 352. I am speaking of the materials which are in the fermenter from the commencement of one crop of yeast to its conclusion. Is it your opinion that the Rainer patent makes no disclosure of the peptone-to-the-sugar ratio in the wort, in that sense?

A. Read the question, please.

(XQ. 352 repeated by the reporter.)

A. It does make a disclosure of the total amount of peptones and the total amount of dextrose or sugar which passes through the wort during the entire process of fermentation. The ratio is two of dextrose to one of peptone.

XQ. 354. Where did you get that from?

A. From the last paragraph, sir.

XQ. 355. Is not the meaning of that last paragraph this, that considering the assimilated peptone and sugar going into the yeast growth, the ratio is, as you have stated, one of peptone to two of sugar?

A. I do not understand it that way. The language to me is very clear. It says:

"According to results obtained up to the present, from 250 to 300 kg of a pure and vigorous pressed yeast

can be obtained from every 100 kg of pure peptone (dry weight), only about 200 kg of dextrose or sugar being required for its cultivation." He does not say that it is the available peptone, but says specifically it is every kilogram of peptone.

I have not calculated the peptone-to-sugar ratio in the third paragraph from the end of Rainer's specification the one which commences "In order to produce a yeast as pure as possible."

XQ. 358. Have you calculated the peptone-to-sugar ratio in the paragraphs of the specification three and four ahead of the one you have spoken of? That is, the paragraphs beginning "Depending on the larger or small density of the nutrient liquid employed," and the following paragraph beginning "When after 6 to 8 hours"?

A. No, sir; I see no basis for making a calculation of that kind.

XQ. 359. After the conclusion of a Rainer operation what does his patent say is done with the spent wort?

A. (No answer.)

XQ. 360. I call your attention to the final clause of the third paragraph from the end of the specification.

A. In that specification the statement is: "whereupon the spent nutrient solution can be drained off into the sewer," which is common practice in all yeast manufacture. There is always a spent solution in every yeast process and it is usual to drain it off in the sewer.

XQ. 361. In considering the disclosure of the German Rainer patent, have you read the British patent to Lake No. 778 of 1880?

A. I have read hundreds of patents, I probably have read it at some time, but I do not recall now what it contains.

By Mr. Watson:

XQ. 331. Is it standard practice to figure water?

A. No.

XQ. 332. On the yield?

A. No, but I am trying to make it clear to the Judge how it would be possible to get perhaps more than——

By The Court:

Q. 333. That occurs, I suppose, because the yeast grows, isn't that it?

A. That is correct, sir.

Q. 334. So you could take out 125 per cent. of what you put in, just as when you put a seed in the ground you could take out ten of them?

A. That is correct, sir.

Mr. Philbin: Yes, sir.

Mr. Watson: Not quite the same, but——

A. (Continuing.) Well, it is the same process. That is what I mean.

Mr. Watson: The ground has got more nutriment.

The Court: Oh, that makes it reasonable to me, being a farmer and not a chemist.

By Mr. Watson:

XQ. 335. Now, will you express the yield of yeast on what Rainer calls the pure peptone as a basis?

A. The yield of yeast on the basis of pure peptone is 150 to 200 per cent. I make that calculation from the fact that he had 100 kilograms of peptone and he received 250 to 300 kilograms of yeast.

XQ. 337. And what would be the yield on the peptone basis?

A. On the peptone basis it would be 150 and 200 per cent. additional material.

XQ. 338. 250 and 300 per cent.?

A. I beg your pardon. It would be 250 and 300 percent on the 100-kilogram basis. The increase, I intended to say, was 150 to 200 kilograms.

XQ. 339. What materials and what quantity of them are disclosed by Rainer as required to make 100 kilograms of his so-called peptone on a dry weight basis?

A. He does not disclose the quantity in any other place than in the last paragraph; he duplicates them.

XQ. 340. Well, he discloses the cereals, does he not, of which he makes his peptone?

A. I was talking of the quantity, sir. The quantities disclosed are 100 kilograms of pure peptone and 200 kilograms of pure dextrose.

XQ. 341. I will divide my question. What cereals does he disclose as those from which he makes his peptones?

A. The cereals are given under the generic term cereals, grain, gluten, industrial offals such as bran, malt materials, malt germs, i. e., malt sprouts, nutrient, etc. These cereal materials from which Rainer makes his peptone must be considered in arriving at the cost of Rainer's raw materials.

He does not speak of or disclose the quantity of those materials required to make 100 kilograms, for example, of his peptone by dry weight. I do not know what quantity will be required for that purpose. I never made an experiment to ascertain that. Of these cereal materials which Rainer makes, I do not know what would be better for his purposes than malt sprouts. I do not know whether any of those mentioned would give more of his peptones for his purposes without malt sprouts. I do not know how much peptone Rainer would obtain by his peptonization from a given amount of proteins in his cereals.

XQ. 362. I will give you a copy of the Lake patent in a moment, Dr. Rautenstrauch. In the meantime will you just refresh your recollection of the Rainer German because I want to ask you whether this Lake patent is the British patent covering the same subject matter as the German to Rainer.

MR. PHILBIN: May it please the Court, asking the witness about a Lake British patent does not seem to be proper cross-examination. The witness has said he has not read this Lake British patent in connection with the preparation of this particular case. It was not, of course, referred to by the defendant. It is not in evidence. And it seems to me a waste of time to ask the witness to read now this rather long patent, and interrogate him concerning it.

MR. WATSON: I have but one question on the patent, if the Court please, and the patent was pleaded in defendant's answer,

THE COURT: Oh, was it?

MR. PHILBIN: But it is not in evidence.

MR. WATSON: It is the British patent corresponding to the German, and the witness has expressed an opinion, your Honor will recall, on the significance of a comma.

THE COURT: Yes.

MR. WATSON: This British patent which corresponds, divides that sentence into two and places a period at that point. I merely want to ask the witness whether he interpets the British patent as he did the German with respect to that point.

THE COURT: I will allow it.

MR. PHILBIN: Your Honor may recall that the question about commas and semicolons and colons

came up only because plaintiff's counsel spoke about punctuating, and there should be a colon——

THE COURT: Yes, that is correct.

A. I think I am prepared to answer your question, sir.

XQ. 363. This patent does correspond?

A. Yes, sir. In support of that answer I would like to quote from the patent as follows: "When the entire amount or bulk of the dextrose or other sugar added to promote the growth of the yeast has been consumed after from 6 to 8 hours, a further quantity thereof, say, from 1/20 to 1/10 per cent. is added. The peptone may also, after having been consumed, be added in portions, or may be allowed to flow in gradually and continuously." I take that to mean, sir, that the specification "allowed to flow in gradually and continuously," in view of the "also," referred not only to the peptone but also to the dextrose.

MR. PHILBIN: I should add, your Honor, that we place no emphasis whatsoever upon where a comma may be, or where the semicolon may be. It does not seem to us of any importance.

XQ. 364. The questions 46 and 47 and the answers in your direct examination read as follows:

"Have you ever seen any evidence that yeast, when it has sugar which it can eat, consumes the alcohol which the yeast has excreted from sugar?

"A. I have been able to discover no evidence that that takes place. If it does take place, it is so small that we are not able to measure it.

"Q. 47. Would it have any practical importance?

"A. I think not, sir."

In view of this testimony, I ask you if it is your opinion that if any alcohol is formed in the yeast

propagation, it will not be consumed by the yeast in the process?

A. It is my opinion, sir, that when alcohol is formed during the process of yeast propagation, it does not tend to be consumed by the yeast, particularly in the presence of sugar.

XQ. 365. Is it your opinion that in the yeast-manufacturing process, to the extent that alcohol is formed from the sugar, the nutrient material is to an equal extent removed from being available for yeast propagation?

A. That question, I must be frank to say, has no meaning to me.

XQ. 367. When alcohol is formed in such a process it is formed from sugar, is it not?

A. That is correct.

XQ. 368. And so much sugar as is converted into alcohol cannot be converted into the manufacture of yeast, is that your opinion?

A. I understand your question now, sir, which is that if the sugar is converted into alcohol and after it has been converted into alcohol is not available as a food for the yeast.

XQ. 369. That is correct?

A. That is my understanding, sir.

By The Court:

Q. 370. I understood you to tell counsel that no one knows whether or not the yeast consumes the alcohol.

A. I made that statement, sir, and in view of that statement my own reflections lead me to the conclusion that it does not consume the alcohol.

Q. 371. That is your opinion?

A. And I am one of those who takes the position on the side where it does not; there are others who claim that it does.

By Mr. Watson:

XQ. 372. What do you base that opinion on?

A. I base that opinion on my general knowledge of the fact that the plant which excretes material does not tend to then consume what it has excreted.

XQ. 374. That is the only basis?

A. Well, that and in the light of the computations that might be brought about, and the understanding of the process. I might further add that should there be found by someone some evidence, which apparently does not exist at the present time or else there would not be this difference of opinion, that alcohol is consumed by the yeast, my opinion would be that it would be very small, but the fact that there is that difference of opinion leads me to conclude that the amount must be very small or else it could be very definitely determined. I can cite no scientific authorities published as references at the moment, in support of the opinion which I hold, sir, but I have studied the problem over a period of years and it has been the general impression I have gained from reading and conversations with those who are trained in that field.

I do not know the theoretical conversion factor of sugar into alcohol in the fermentation process of making alcohol nor the commercial yield in making alcohol by fermentation from sugar. I do not recall what the best commercial practice, at any time during the last thirty years, has been in respect to the manufacture of alcohol.

XQ. 380. As I have understood your testimony, you have expressed the opinion that the rule of increasing alcohol production by increasing sugar content or increasing yeast yield by decreasing sugar concentration was known for a period from 1897, the Rainer patent, for example, is that correct?

A. That is correct, sir.

From what I have learned of the commercial processes of yeast manufacture as conducted to a time prior, let us say, to 1916, it was generally commercial practice to operate with the straight-set mash. I have no direct experience, my own experience, to the contrary.

During the same period referred to, I do not know what the commercial practice was with respect to the initial Balling of the wort.

XQ. 384. Do you know that it was relatively high compared with more recent practice?

A. That is correct, sir.

XQ. 385. And you know that in that commercial practice of yeast manufacturers, continuous quantities of alcohol were also produced as a by-product?

A. Not always as a by-product, by direct design, because most of the yeast manufacturers were producing both yeast and alcohol. So that you might call the yeast a by-product and the alcohol a product.

XQ. 386. That is immaterial, from my point of view. I am just asking the fact whether in all of that commercial practice alcohol was produced in considerable quantities.

A. That is correct, sir.

XQ. 387. Inasmuch as you have stated that the commercial practice for the period of thirty-six years included the use of straight set mashes and the use of such mashes of relatively high Balling, is it your opinion that that commercial practice departed from the use of relatively high dilutions of sugar because the use of relatively high dilutions of sugar would have entailed other and overbalancing disadvantages?

A. No, sir.

XQ. 388. In your opinion, what is the reason the art persisted for thirty-five years or more in using high Balling straight set worts?

A. I will be very glad to answer that question, sir. Prior to 1914, and years perhaps prior to that, the desire was to create yeast and alcohol. All during that period the art was advancing and developing and people learned how to produce yeast without much alcohol by having dilute solutions, but, as in many arts, it was not availed of until commercial circumstances made it desirable. We find that in almost all the arts. The commercial circumstances which made it desirable were, in this country Prohibition; in Germany, particularly, the desire was to grow yeast for its food value, particularly for stock food. Germany was then at war, was pressed for food for its——

MR. WATSON: Can we confine the answer, if the Court please, to United States practice?

MR. PHILBIN: That wasn't the question, your Honor.

THE WITNESS: I am answering the question.

THE COURT: Proceed, Doctor.

A. (Continuing.) In Germany, the desire for stock food was so pressing that these people began to avail themselves of what was known in the art, and from the fact that the art had been so thoroughly developed in regard to the possibility of growing yeast without alcohol they could do it quickly, there was no long period of experimentation, and the Germans immediately got into the production of yeast instead of alcohol, and were able to do so because of this art which had been established; and it is because of these commercial conditions that that conversion was made, and because of the fact that this art was revealed in the literature and the patents they could do it quickly, and there was no long period of experimentation.

XQ. 389. You say the desire influenced the commercial practice, and you stated that the desire was to

make yeast and alcohol. Can we go a little further back and say that the manufacturer's desire and the usual and normal desire was to get products of the greatest value from his given raw materials?

A. In Germany that value being measured in nutrition for cattle, and that was the value which they were seeking. In the United States the value of alcohol was destroyed by Prohibition; unless, of course, you wanted to be a bootlegger.

XQ. 391. Well, do you think that the motive of yeast manufacturers, contrary to the customary motives of industrialists, was to get products of lesser value from their raw materials than they might have?

A. You have no right to draw that inference from my statement, sir.

XQ. 392. I thought not, and therefore, I ask you whether you agree with me that that was the dominating motive and desire of the yeast manufacturers, to get products of the greatest money value from their given raw materials, and that that motive obtained during the thirty-six years I have referred to, and still obtains?

A. That is correct; but when there is a change in the commercial conditions under which the products may be merchandised, and one of those products is prohibited, then naturally that product is eliminated, as far as possible.

I do not know the fair, typical selling prices of bakers' yeast or alcohol over the period from Rainer to 1916 in general or any particular portion of this period.

XQ. 396. In your opinion does the Rainer reference or the Jacquemin reference show any withdrawal of yeast and then a dilution of the remaining wort by the addition of a nutrient solution less concentrated than the wort to which it is added?

THE WITNESS: I find nothing in these patents that I recall in which the nutrient solution added is less concentrated than the wort to which it is added.

XQ. 397. Do either of those references, in your opinion, show the withdrawal of yeast from the vat and then a dilution of the remaining wort by additional water?

A. The Rainer patent states specifically: "The yeast produced likewise is withdrawn successively and only the yeast which is still suspended in the liquor itself remains behind as a seed for the alcohol ferment still to be formed." There is no specific statement that water is added. I assume that the author is writing this in view of the state of the art or what is known in the art.

XQ. 399. Can you answer as to the Jacquemin reference?

A. In the Jacquemin patent, beginning line 20, reference is made to the transfer of yeast from one receiver to another in these words: "this first Yeast is passed into another receiver C of a larger capacity, and sterilized wort from the sterilizer A is poured on this Yeast, which results in a new and very important multiplication of Yeast. These substances or materials are then aerated during about 12 hours, and a certain quantity is then drawn off by the cock P into a vat D standing on legs and which is then charged with wort. In this way, a third Yeast is obtained which as soon as made is directed according to the requirements of the manufacture into the fermentation vats E.

"The quantity of Yeast taken from the receiver C is replaced by an equal quantity of sterilized wort from the sterilizer A, and so on for each three, four, five, or six hours depending on the number of vats to be fermented during 24 hours or longer, and according to

whether the Yeasts remain pure, or commence to be contaminated."

I understand this to mean that as yeast is withdrawn from one fermenter it is applied in another fermenter and additional wort is added to continue the process of fermentation.

XQ. 400. My question, however, refers to the addition of water and your answer has not been responsive so far. Can you say whether the process shows the addition of water?

A. Well, I thought that we all knew that wort did contain water in that respect.

XQ. 401. But it is a more concentrated wort, is it not?

A. I do not see any reference to its concentration. Perhaps if it was more concentrated they would add water.

XQ. 402. Do they add water in this reference to bring back the concentration of the wort to its starting condition?

A. I think that is what is intended, sir. There is no direct specification that water was added.

By THE COURT:

Q. 403. Do you know where the word "wort" was derived from?

A. I think it is derived from the German, sir.

Q. 404. How do you pronounce it?

A. Wort, w-o-r-t.

By MR. WATSON:

XQ. 407. Refer again, please, to the second patent in suit, '105. In your opinion, does this patent teach a feed of the concentrated reserve wort at a rate in accordance with the food requirements of the yeast for propagation?

A. That all depends upon what scope you give to the word "teach." It certainly does teach that the wort is to be added as required for the nourishment of the yeast.

XQ. 408. That is sufficient. And during the period of propagation the food requirements of the yeast increase; is that not true?

A. The total yeast mash, because there are more cells to be fed, sir.

XQ. 409. Is it your opinion, therefore, that the disclosure of the patent teaches a feed-in at an increasing rate?

A. One skilled in the art, familiar with the practice, as a matter of practical operation, would increase the feed.

XQ. 410. Now, I will have to repeat my question and ask you whether the disclosure of this patent will teach one skilled in the art to feed in at an increasing rate in accordance with the food requirements of the yeast as it multiplies?

A. Yes, I should think so.

XQ. 411. Referring to the 3 to 5 degrees Balling reference at line 90 of page 1 of the patent, in your opinion, if you start the propagation with the diluted portion of the wort having a Balling of about 1 degree, how fast would you feed in or would you build up the concentration in the propagating vat to 3 or to 5 degrees Balling?

A. That is not specified and not known until you test the rate in relation to the Balling of the mash.

XQ. 412. Is it your understanding that this sentence of the patent instructs one to follow that procedure?

A. No, it is not.

THE COURT: Does it when coupled with the knowledge of the art?

THE WITNESS: Yes, I should think so, your Honor. One skilled in the art would naturally determine a rate of feed which he wanted in accordance with the Balling of the mash.

XQ. 414. Well, following the Court's inquiry a little further, is it your opinion that one skilled in the art would feed in to the diluted initial portion which started at 1 degree Balling at such a rate that during the yeast propagation the Balling would rise to 3 or 5 degrees?

A. According to the teaching of the patent, I see no other meaning to it.

XQ. 415. In view of your experience in the manufacture of bakers' yeast, do you know whether the result of carrying out that procedure would be to supply yeast nutrient faster than the food requirements of the propagating yeast?

A. Your question doesn't tie up to the——

XQ. 416. I am asking you this as an independent question.

Mr. Philbin: May we ask Mr. Watson to clear up what he meant when he said "that procedure"?

Mr. Watson: The procedure we have been discussing, namely, the commencement with a diluted portion of 1 degree Balling and a feed-in with a more concentrated reserve, so that the Balling in the propagating vat would raise to 3 to 5 degrees.

A. If I understand your question correctly, you want to have me answer whether or no in my opinion a 3 to 5 degrees Balling is a desirable Balling on the average if you want a large yeast growth with little alcohol. Am I correct in that interpretation?

XQ. 417. Well, no, not quite. I think the question was self-contained and needs no amplification, but I will give it, if you wish?

A. I would like to have it clearer.

XQ. 418. The sentence beginning at line 90 of page 1 of the specification says that "The quantity of the diluted wort which is originally available for the yeast is so chosen, for example, that the mean content of the entire wort employed would be 3° to 5° Balling."

I understand your opinion to be that this would teach one, for example, to start with a Balling of 1 degree in the diluted fraction and feed in a concentrated reserve having a Balling, for example, of 12 degrees, at such a rate that the mean Balling in the vat would reach 3 to 5 degrees. Is that correct?

A. That is the way I interpret this sentence.

XQ. 419. Now, I am asking you, if one carried out the procedure that way, do you know whether it would entail supplying the reserve wort faster than the food requirements of the yeast for propagation, and would be accompanied with the production of substantial amounts of alcohol?

A. With the average mash now employed it would feed the sugar in faster than the yeast consumed it, and would tend to produce alcohol.

XQ. 421. Now, refer to the Delbruck article; is it your opinion that this discloses beginning the fermentation in a relatively dilute wort?

A. Yes, it does.

XQ. 422. And you base that opinion on the end of the tenth section which states that according to which, first of all, the innoculating yeast, with but little wort, is put into the fermentation vat.

A. That is correct, sir. It refers to a stream of fresh nutrient liquor which is run in continuously for a period of twenty-four hours. In that paragraph it refers to the wort having a low Balling from the beginning and by a continuous feeding supplying the material first to the vat.

XQ. 423. Where do you find, in that paragraph, the use of the words "of low Balling"?

A. It says, to place in a large fermenter or fermentation vat the innoculating yeast together with a little wort. That I read also in connection with paragraph 7 where he states "worts and mashes of a concentration

which permits of exceeding this alcohol content (4 per cent.) do not give the yeast multiplication corresponding to the nutrient content." He speaks of a wort concentration, so I assume in the light of that paragraph, and as one would commonly understand the language, that wort is diluted in the large fermenter and then the nutrient liquor is run in continuously during the process of fermentation.

XQ. 424. What does the final sentence of the paragraph of the seventh section say as to Balling in process?

A. There is a reference to Balling in terms of a saccharimeter in which the sentence is: "Manufacturers of yeast who operate with wort have a wort concentration of perhaps 7 per cent. on the saccharimeter," which means 7 degrees Balling.

XQ. 426. Do you know whether, in commercial practice, the alcohol manufacturers have not always used much higher concentration expressed in Balling?

A. I am not familiar with alcohol manufacture.

XQ. 427. In a wort concentration of 7 degrees Balling, do you know whether it would be possible to obtain 4 per cent. of alcohol?

A. I have no knowledge of the relation between Balling content and the alcohol. I rather suspect that there would be some alcohol there. Understand this, that the author is writing about how to practice the manufacture of yeast, to the manufacturers of yeast who operate with wort and with a wort concentration of perhaps 7 per cent. on the saccharimeter.

XQ. 428. With such a Balling of wort, if all the sugar was converted into alcohol, do you know what the percentage of alcohol would be?

A. I think your question has a contradiction because, with the 7 per cent. Balling, my understanding is that all the sugar can not be converted to alcohol.

There is some yeast produced. This 7 per cent. Balling on fermenting would produce alcohol. I do not know how much alcohol could be produced from the sugar in that 7 per cent. Balling wort. I think, however, that perhaps some light on the situation might be gathered from the previous sentence, which says: "As a rule, 4 per cent. of alcohol by weight tends to limit multiplication. Wort and mashes of a concentration which permit of only this alcohol content do not give the yeast multiplication corresponding to their nutrient content." So I take it that the author is writing for the purpose of instruction, calling attention to the fact that a high Balling might result in a high value of alcohol, and as a result yeast multiplication is deterred.

XQ. 431. Now, start with the 7 degrees Balling wort; if he gets a production of 3½ per cent. of alcohol, he has an alcohol yield of 50 per cent. on his sugar, is that correct?

A. I don't know, sir.

XQ. 432. You occupied the chair of mechanical engineering, before industrial engineering, at Columbia, did you not?

A. Yes, sir.

XQ. 433. And you held that for fifteen years?

A. Just about.

By THE COURT:

Q. 434. A large part of mechanical engineering is chemical engineering, isn't it?

A. No, sir.

Q. 435. None of it?

A. Mechanical engineering deals very largely with the design and operation of manufacturing equipment.

By MR. WATSON:

XQ. 436. You are not a chemical engineer, are you?

A. No, sir. Industrial engineering. May I explain that a little further? Industrial engineering has to do with putting into practical operation the work of other engineers, including chemical engineers. So that an industrial engineer will bring to practical fruition the inventions of chemical engineers, biologists, electrical engineers—that is, expressing these arts in practical operations.

By Mr. Watson:

XQ. 437. You have been a consultant for various people in reorganization of companies?

A. Yes, sir. I was with the J. G. White Management Corporation. Their business was to operate public utilities, and also to develop manufacturing industries. I was also with the Fred F. French Company. Their business was real estate, building. I was with the Splitdorf-Bethlehem Electrical Company. Their business was electrical manufacturers. I went with the Liberty Company, I think in February of 1923.

XQ. 446. In XQ. 140 you were asked: "Did you know the operations of that company before you went with them?" That is the Liberty Yeast Company. And your answer reads: "I did not." As a matter of fact, before you went with the Liberty Yeast Company you investigated the company and its operations, did you not?

A. Yes, sir. I assumed my connection began with the time I conducted the investigation.

XQ. 447. And after going with the Liberty Company you had full authority, did you not, over the process of yeast manufacture which they followed?

A. Yes, sir.

XQ. 448. And you were familiar with them?

A. Reasonably, yes, sir.

XQ. 449. Isn't it a matter of fact that the yeast manufacturing process employed by the Liberty Yeast

Company before you joined them in the beginning of 1923, was a straight set mash operation?

A. I think not, sir. Prior to that time the Liberty Company had been employing the Harrison and Nilsson, a straight molasses process. That process included the use of inorganic salts and a neutralizing agent. That was a straight set mash operation.

XQ. 452. Some time after you went with the company they changed their process to include the regulated feeding in of the more concentrated wort to a diluted wort, did they not?

A. I cannot recall whether that occurred after my connection with the company or just before it.

XQ. 453. That change resulted, did it not, in considerable profit to the Liberty Yeast Company by way of its manufacturing cost operations?

A. It is hard to separate just what effect that may have had on the profits of the company, but the company was very profitable under my management, sir.

XQ. 454. And you testified, did you not, for the Federal Yeast Corporation in one of the Baltimore cases?

A. Only before the Master in the accounting.

XQ. 455. Yes, I understand that. But in that testimony did you not ascribe the major improvement in its financial condition to the change from what you have said is the Nilsson and Harrison process to this regulated feed-in process?

A. I do not recall, it has been so long ago. If you wish to save time, sir, I am very glad to admit that the regulated feeding did bring about an increase in the yield of yeast and as a result of that increase in yield the company was in a more profitable position than it was before. After that process was installed and used our yields were as high as 70 per cent. and 75 per cent.

sometimes. As to the yield on the prior process from my investigation of the company I think we found that the yield was in the neighborhood of between 40 and 50 per cent.; that is my best recollection. The basis of that yield in both those instances was on the total weight of material put into the fermenter, not including the water. The yield I speak of was pressed yeast.

XQ. 460. Have you refreshed your recollection overnight as to the Ballings employed by the Liberty Yeast Company when you were with them?

A. No, I did not. I didn't see any of the mash sheets. My general recollection is that they were low Ballings.

XQ. 461. I show you a photostat entitled Liberty Yeast Corporation, dated May 19, 1923, and ask you if that is a photostat of one of the Liberty Yeast Company's mash sheets at that date?

A. Yes, it looks very familiar. That shows a manufacturing process.

The process was a feeding-in process as indicated on the left-hand side of the sheet where it refers to the run of the mash, running the mash in, and shows the use of inorganic salts and neutralizing medium, i. e., ammonium phosphate and aqua ammonia. The concentration in the propagating vat, as indicated by the Balling figures, varied from 1.3 to 2.3. The Balling at the start was 1.8. The Balling figures are those which appear in the second column from the left-hand side.

MR. WATSON: I ask that the photostat shown the witness be marked Plaintiff's Exhibit 17 for Identification.

(Received and marked Exhibit P-17 for Identification.)

XQ. 468. I show you another photostat of a mash sheet dated January 8, 1923, and ask you if this also shows the operations of the Liberty Yeast Company at that time?

A. It is written on the letterhead and I assume that it does belong to the Liberty.

I rather suspect from the indications that that was a straight set mash operation. The Balling figures there also are given in the second column from the right, or from the left. And those Ballings run from 3.6 at the beginning to 1.6 at the end, decreasing consistently over the period.

MR. WATSON: I ask that the photostat be marked Plaintiff's Exhibit No. 18 for Identification.

(Received and marked Exhibit P-18 for Identification.)

XQ. 473. Is the operation shown on the sheet last handed to you what you refer to as the Nilsson and Harrison process followed by the Liberty Yeast Company?

A. Well, I have no way of identifying that but I assume that it was.

MR. PHILBIN: We are willing to accept Mr. Watson's statement that that was the Liberty Yeast process, but these things happened ten years ago and it is very difficult for the witness to identify them. If Mr. Watson says that they are we will accept that.

MR. WATSON: I will say that they are.

MR. PHILBIN: I still don't see the pertinence.

THE COURT: What is the point here, Mr. Watson?

MR. WATSON: One of the points, if the Court please, will be to have evidence helpful to us in evaluating the opinion expressed by the witness as to the meaning of the sentence in the second patent in suit, which refers to the——

THE COURT: 3 to 5 degree Balling?

MR. WATSON: 3 to 5 degree Balling.

MR. PHILBIN: I do not see what possible pertinence what the Liberty Yeast Company did in 1923 or 1924——

THE COURT: What is the date of the patent?

MR. PHILBIN: —has to do with the——

THE COURT: What is the date of that patent?

MR. PHILBIN: 1915, your Honor, as filed in Germany. How can what the Liberty Yeast Company did in 1923 or '24 be used to interpret what Mr. Hayduck says he meant when he filed an application in 1915?

MR. WATSON: It can't, Mr. Philbin, but it can be used to judge this witness' present opinion of what that patent discloses.

THE COURT: You are using it, then, to test the qualification of the witness, is that it?

MR. WATSON: Correct.

That is all, Mr. Philbin.

RE-DIRECT EXAMINATION BY MR. PHILBIN:

RDQ. 474. Dr. Rautenstrauch, you were asked on cross-examination how long you had spent in studying the prior art patents and publications to which you had referred in your testimony "in preparation for the testimony that you have just given," and your answer was that it had only been a comparatively few

days, in preparation for the testimony that you had just given. Now, will you tell us whether you had ever studied any of these patents in suit, or the prior patents and publications to which you have referred, before you commenced to prepare for the trial of this particular case?

A. Ever since my connection with the Liberty Yeast Corporation I have had occasion not only during my time with the Yeast Corporation but from time to time thereafter to make use of the extensive library on yeast patents and the literature in the yeast art which I had accumulated, which I think is one of the largest libraries that any individual outside of the yeast business has, and I have studied the problem in Europe, I have studied it here. So that I would say that for the past thirteen years I have been familiar with the yeast manufacturing art, the patents relating to that art, and during the past ten years have on a number of occasions had reason to and did refer to the yeast patents and the art.

I would judge offhand that I have several hundred patents; the number of articles which I have relating to the researches and experiments done in yeast manufacture I can't tell, but they are quite voluminous, in English, French and German.

RDQ. 476. When you were with the Liberty Yeast Corporation in 1923 and 1924 and 1925 and were in charge of its business, did you have any occasion, then, to examine any of the patents in suit, which include Hayduck patents '103, '105, '106 and '109?

A. Yes, because of the fact that we wanted to know what was in the art that was patented; we wanted to avoid litigation; we wanted our process and improvements, if they were patentable, to be patented. And that was one of the reasons why we kept ourselves

informed and I kept myself informed particularly on the state of the art as expressed in the literature and the patents.

This book of some sixty or more pages entitled, "Preliminary Memorandum of Fleischmann patents and General List of Yeast Patent References, Translations and Foreign Patents," etc., January, 1924, came from my office. This particular file was made in January, 1924. It contains a list of various patents, including the Hayduck patents, and references, discussing them, such as Jacquemin and Polsky, Rainer.

RDQ. 480. Who made up the material and data which went into that book?

A. Well, I find a number of indications here that you were helpful in the matter. I find some of your handwriting in here, so I assume that you were part of this program.

The Liberty Yeast Corporation was sued by the Fleischmann Company in 1924. I find that the following patents were in that suit, Hayduck Patent No. 1,449,103; 1,449,105; 1,449,106; and in addition to those patents which are also here in suit, the Hayduck Patent 1,449,102, Pollak Patent No. 1,123,920; Nilsson and Harrison Patent No. 1,449,127; Wohl Patent 1,449,134; Kohman et al. Patent No. 1,475,494; Wohl Patent 1,475,215; and Corby Patent 1,475,471—that is not the Corby patent in suit here. They are old familiar friends. As to the part I took in studying those numerous patents that were there in suit and in preparing the defense against those patents, I not only examined the prior art but I also went to Europe and consulted with a number of the experts in Europe who had been developing the art and had obtained patents. I talked with Dr. Henneberg, in his research laboratory at Kiel, and I visited Vienna and talked with Molhant, and others in that vicinity, and Dr. Schendler, who was in Germany, the co-inventor with Claudon, and

Dr. Plesser, in Darmstadt, and many others who were active in the development of the yeast art.

RDQ. 484. Can you give us an idea about how much time, while you were with the Liberty Yeast Corporation, you spent in work connected with this patent suit and in preparing the defense, etc.?

A. That is a very difficult matter to state, but it took too much time, I know that, as far as the business was concerned. I should say it took at least a third of my time, because that was a very distressing problem. That case was never tried. Fleischmann laid four million dollars down on the table for our business and we accepted it. You were the patent counsel associated with me at that time in the preparation of the defense of that case. At that time I examined patents and publications to Rainer, Lavedan, Henneberg, the Henneberg articles, Pure Products article, Delbruck, Pollak, Polsky and Jacquemin. They are all old familiar articles.

I was asked in connection with Defendant's Exhibit D-3, which was a sketch drawn during my direct examination and while I was on the stand, on cross-examination, as to whether it indicated in any manner defendant's process, and I said that so far as it went it did indicate defendant's process. What I meant by that statement was, just as I said, it does indicate in one place, the figure on the left particularly the grain tank, an element employed in the defendant's process. The figure to the right is addressed to an entirely different process, so I think my answer was correct, that this sketch does contain an element of the defendant's process, but I do not wish that to be understood to apply to the entire sketch being inclusive of the defendant's process. I understand defendant uses grain, molasses and inorganic salts in its process.

I was also asked on cross-examination about yeast consuming alcohol and I said several times that, in

my opinion, it would not do so. With respect to all such statements I was assuming that the discussion was with respect to worts of the kind that have been discussed here and that there was available in the wort sugar which the yeast might consume, and I so stated that, in the presence of sugar.

I was also asked with respect to commercial manufacture of yeast as to different processes. One of the controlling considerations for yeast manufacture is the prices of the raw materials at the time that the manufacturer buys them. Another consideration is the demand and prices for the particular product that he is selling, whether it be alcohol or yeast.

The demand for bakers' yeast has increased in the past few years because the rate at which bread is being made in the bakeries as compared with the homes has increased, and also the population has increased.

RDQ. 499. How long has that change been going on of more yeast being used by the bakers and less yeast by the housewives in the home?

A. We made a study of that when I was with the Liberty Yeast Company. I forget how far back our records went, perhaps not beyonds the '90s, but since that time, I recollect quite clearly that the bakers were baking more and more bread, and the public was consuming more and more yeast.

RDQ. 500. You were asked about this Hayduck '105 patent relating to regulated feeding. Do you understand that that patent says you should feed at such a rate as to give proper nourishment to the yeast, and so as not to form undesired alcohol?

A. Yes, it does.

RDQ. 501. Does it also say, as you understand it, giving as an illustration, that the average Balling content or mean content of the wort should be between 3 to 5 in the vat as the yeast consumes the nutrients?

A. That is my understanding of what that patent says.

RDQ. 502. Is there any other instruction in the patent as to what the rate should be of feeding the reserve solution into the vat, except first that it should be at a proper rate not to create alcohol and that it should be at a proper rate so as to feed the yeast correctly, and that the mean Balling should be between 3 to 5 per cent.?

A. I find no other specification which would instruct one as to what that rate is specifically.

MR. PHILBIN: That is all.

RE-CROSS-EXAMINATION BY MR. WATSON:

RXQ. 503. You have been asked about the mean or average Balling of the Hayduck Patent '105. If the mean Balling is between 3 degrees and 5 degrees is it your position that that requirement can be satisfied without ever achieving a Balling in excess of that mean?

A. From the instruction in the patent, if you start with a 1 degree, you can keep your Balling between 3 and 5 without exceeding the 5 as a mean.

RXQ. 504. If you keep your average Balling?

A. Yes, between 3 and 5.

RXQ. 505. How can you do that?

A. By varying the rate at which you feed in the wort to your tank.

RXQ. 506. Well, if you are going to get an average and start with 1 degree Balling, it seems to me that sometime you will have to have a Balling in excess of what your final figure will be as the average?

A. Not necessarily. Understand, if he had said 5, then it would have been greater, but he said 3 to 5. So that you can have a mean between 3 and 5 without ever exceeding the maximum 5.

RXQ. 507. I am beginning to understand your position. It hasn't been quite clear heretofore.

A. May I explain my position a little further?

RXQ. 508. I would like to have it as fully as you can explain it.

A. We want the Court to understand this thing.

By THE COURT:

Q. 509. I think I understand it.

A. You think you understand it?

Q. 510. And I will give it to you in a homely way, perhaps.

You say that in the feeding-in process—that may be stopped at a point, we will say, somewhere between 3 and 5 degrees Balling. Five is the limit beyond which you must not go. You, who are experts in this business, discover that if you turn it off at 3.1, we will say, and the process is continuing, that may get up to 4, but it won't get beyond 5. Is that right?

A. That is correct, sir; and you will have an average of somewhere between 3 and 5. May I explain a little further, because——

MR. WATSON: I will be glad to have you do so.

A. (Continuing.) Because I think it is very necessary that the Court understand the situation.

We have no knowledge, sir, of the density of the wort which Hayduck used. Balling, you will remember, is really a measure of density.

Q. 511. Of sugar?

A. It measures the sugar only relatively. So that if other ingredients in the mash add to its density——

Q. 512. Well, now, just a minute. The Balling gives the density from which you calculate the sugar, is that right?

A. That is correct, with this limitation, sir; if I should have two vats, and there is in the one a 3 per cent. Balling and in the other a 3 per cent. Balling, that does not mean that the sugar content or the sugar dilution or the sugar concentration in these two vats is the same because——

Q. 513. As I understand this feeding-in process, you can stop it somewhere below 5, at a point where when all the process is operating, the growth of the yeast, the chemical changes that take place, the feed will not cause the wort to get above 5. I see no difficulty in understanding that, for a totally different reason. Some of you, probably, have had experience with coal furnaces in the home, and you know that if you watch a thermometer with a coal fire and the room is 70, then you throw off the thermostat, that room will come pretty near being 80 before it goes down. Now, then, when you take an oil-burning system or a gas system, and you want your room at 70, it goes to 70, but it will go no higher than 70; it can't, because it is immediately shut off, and all heat is shut off, so it doesn't get above that point. Why isn't that somewhat similar to this proposition of feeding in for the purpose of keeping the Balling measurement within the limits of 3 and 5? I just want to know if you and I, Mr. Watson, are thinking about the same idea.

MR. WATSON: I thought I could perhaps bring it out a little bit on the record through the witness.

THE COURT: Very well.

By MR. WATSON:

RXQ. 514. In all of these feed-in processes, is it not a fact that if the feed is stopped, the Balling in the propagating vat from that moment, during continued propagation, will decrease?

A. That is correct, sir.

MR. WATSON: There is no tendency, if the Court please, for this carry-over of heat reserve, in your analogy of a furnace.

THE COURT: It will never get any higher than——

MR. WATSON: It will never get any higher than it gets by the feed-in of the more concentrated reserve. There is never any tendency for it to increase beyond that point, because on the contrary, the yeast is eating the sugar.

THE COURT: Why should there be any dispute about it at all, if that is the case? You can shut it on and off to suit yourself when it reaches any degree Balling you want between 3 and 5?

MR. WATSON: I think, if the Court please, we will have to reserve our full comments on that point, for our rebuttal.

THE COURT: Because then you will be more familiar with it, I suppose.

MR. WATSON: It has already got to a rather complicated stage, and while the patent has been in litigation for a good many years, an interpretation has been placed on that language here by this witness which has never been placed upon the language by any witness in the prior litigation, or by the Court. Now, I think the easiest way to clear it up will be through our witness in rebuttal.

RXQ. 516. You referred to a trip to Europe and an inspection of yeast-manufacturing processes in use there. Did you make such a trip during your preliminary investigation of the Liberty Company's business?

A. No.

RXQ. 517. Before you actually joined them?

A. No, sir, I did not. That trip was after I joined them. Perhaps about a year and a half after.

EDWARD E. FREE, called and sworn for the defendant, testified as follows:

DIRECT EXAMINATION BY MR. PHILBIN:

MR. PHILBIN: I wish to ask Dr. Free certain questions regarding some tests that he made and the results.

THE WITNESS: My name is Edward E. Free, consulting chemist, 175 Fifth Avenue, New York City. I am a member of the faculty of New York University. As to my technical education and experience I was graduated from Cornell University with the degree of A. B. in chemistry, and from Johns-Hopkins University with the degree of Ph.D. in biochemistry. The subsequent experience—I was for a year a chemist of the State of Arizona; for five years in the United States Department of Agriculture as a chemist and scientist, and since 1912 I have been practicing my profession as a consulting chemist.

Q. 4. There is in evidence as Plaintiff's Exhibit 11 a consolidation of plaintiff's interrogatories and defendant's answers which describes the defendant's processes and which is accompanied by some mash and flow sheets, Plaintiff's Exhibits 13, 14 and 15. Have you investigated the effects in worts such as those described in the answers to plaintiff's interrogatories?

A. Well, I have not carefully studied this combined answer. I assume it is the same as the original answer filed by the defendant, which I have studied; and I have made tests on certain characteristics of worts similar to those covered in that answer to the interrogatories.

I made tests on a wort made from molasses, grain and inorganic salts. In some of the tests I employed the relative quantities of those materials that were in the answers to the interrogatories. As to how these tests were performed, that depended on the purpose of

the tests. Wherever we were testing fermentation reactions, fairly large fermenters were employed. For tests of chemical reactions, chemical characteristics, those tests were made in general in a small scale, a matter of a few hundred ccs., half the size of a water glass, some such quantity as that.

I measured the acid reaction in such a wort in the so-called pH unit, representing the concentration of hydrogen ions. When you are concerned with the effect on yeast, that is the proper way to measure acidity in such solutions.

Q. 12. Now, can you tell us what was the range of non-harmful acidity of these worts, that is, what was the upper limit beyond which the wort solution would be undesirable for the yeast, and the lower limit of the acidity, where the acid would be too small for desirable purposes?

A. Well, in answering that I should specify that I am not answering that as a result, exclusively, of the tests made in that connection, but as a result of my general knowledge of the effect of acid upon yeast. The limits can be considered, I imagine, between 3.5 or 3.8 and approximately 6.0 of the pH scale. I should explain that the pH scale indicates the acid in reverse, the higher pH means lower acidity and vice versa.

Q. 13. In routine manufacture, on a commercial scale, is there any variation in the acidity due to the differences in raw material or changes in temperature or other such instances—in ordinary commercial manufacture?

A. It is my belief that there is, yes, sir.

Q. 14. And how much of a difference in these worts which you have investigated was caused by such routine incidental variations?

A. Well, again I cannot answer that as a result of the specific experiments, but the general fact is that a

normal variation of a wort under ordinary operating conditions would be perhaps .5, that is, 5/10 of a pH unit, with a maximum variation of perhaps as much as 1 pH unit. Of course, variations beyond those limits are not uncommon, but probably would not be regarded as desirable.

Q. 15. And what are the principal acids which are formed during the propagation of the yeast in such worts as used by the defendant?

A. The principal acid produced by the growth of the yeast would presumably be sulfuric acid. It is conceivable that phosforic acid might be produced, although personally I consider that unlikely. It also is conceivable that lactic acid might be produced; I am not certain that it is, it is probable. It is probable that small quantities of succinic acid might be produced, although I am not sure of that, and certain other organic acids might be produced as a result of the growth of the yeast cells themselves. It is not certain that all of these acids would be produced in any instance.

Sulfuric acid is the strongest acid of those I have mentioned. If we evaluate the acids in accordance with the number of grams per liter, the amount of acid in a certain amount of solution, sulfurie acid is the one, in my judgment, most likely to be deleterious to yeast. There are materials in such worts as those I have considered which would counteract the effect of deleterious acid. The most important ones of these, in my judgment, are constituents of the molasses; they are mostly in the nature of complicated salts of organic acids, although other substances also are present, substances which would act to reduce the acid, as measured by the pH scale, in worts of this kind. Those materials which I have spoken of are natural constituents of molasses and grains.

Q. 22. How do they act upon the acid when they are present in the same solntion as acid?

A. Well, by means of a chemical reaction or a series of chemical reactions which take place between those substances and the acid concerned, the number of the hydrogen ions as measured on the pH scale is reduced. The process is often called buffering. It may be considered as a kind of reservoir action. The excess hydrogen ions in the solution are taken up as though they were taken up in a reservoir by the buffer materials. If then something takes place in the solution so that the number of hydrogen ions decreases, another change must take place and they come back from the reservoir into the solution. The effect of those substances is to maintain, approximately, a constant percentage of the hydrogen ion in the solution, that is a constant pH reading more or less, regardless of the total quantity of sulfuric acid or other acid which might be present.

Q. 23. Do these buffer materials combine chemically with acid to form salts?

A. No, I would not say so. Of course, that is somewhat a question of definition as to just what you mean by salt and just what you mean by chemical combination, but they do not combine with acid in the same way as, for example, caustic soda, sodium hydroxide, would combine with sulfuric acid to form a neutral salt, sodium sulfate. The combinations, if any, which occur between the acid and these buffering constituents are adjustable, and they might change one way or the other, depending on what, as we call it, are the equilibrium conditions in the solution.

These buffering materials do not act upon the sulfuric acid in the same way that calcium carbonate or aqua ammonia would act. I have investigated the effect of buffers in worts such as defendant's with respect to counteracting deleterious acidity.

Q. 29. What did you find with respect to the effect of these buffer materials in worts such as defendant's, with respect to counteracting deleterious acidity?

A. Well, as an illustrative example, if you add to a wort such as the defendant's wort, an amount of sulfuric acid corresponding to that which would be produced were all of the ammonium sulfate used converted into sulfuric acid, that amount is approximately .72 of a gram per liter of the solution. If you add that amount of sulfuric acid to the defendant's wort, instead of increasing in pH value to approximately 2, the pH value increases only to approximately 4.2. I must make clear again that I mean when I say increase, the increase of hydrogen ions, which is numerically a decrease in this scale. It is a little confusing, but we are not responsible, any of us, for that scale.

Q. 30. Were these buffer materials enough to take care of any deleterious acidity that might be produced?

A. Yes, sir. That is, I should say that might be produced from the sulfuric acid, as I just described.

I also investigated what effect, if any, ammonium lactate would have in worts such as defendant's with respect to acidity and counteracting the effects of acidity.

Q. 32. And what did you find with respect to that?

A. That experiment was made by taking a wort precisely similar to the defendant's wort excepting that it contained no ammonium lactate, otherwise just the same, and comparing the ability of that wort to reduce the acidity, with the ability of the standard wort containing ammonium lactate to reduce the acidity. Those abilities were found to be closely similar. In the case of the wort with the ammonium lactate, the acidity reached a point of 4.2 on the pH scale. In the case of the other wort, without the ammonium lactate, it reached a point of 4.1 on the pH scale. That is a difference of one-tenth of a pH unit—this, of course, is all dealing with the amount of surfuric acid that I mentioned a moment ago, corresponding to the amount of

ammonium sulfate added at all times to the defendant's wort.

Q. 33. About what percentage was the action of the ammonium lactate with respect to counteracting deleterious acidity with respect to the action of the buffer materials in doing the same thing?

A. Well, in this particular test that I am discussing, the natural buffering constituents in the molasses accounted for approximately 99.8 per cent. of the buffering ability. The ammonium lactate accounted for only approximately .2, that is 2/10 of a per cent., of the buffering ability.

The effect of ammonium lactate was within the range encountered in ordinary manufacturing variations of acidity.

Q. 35. About how many tests relating to the action of these buffering materials and of ammonium lactate did you perform in reaching the conclusions which you have stated?

A. Well, there were some twelve or fifteen series of tests with approximately ten readings, I should say, in each series. I can look up the exact figure, if you wish.

The results that I obtained agreed with my understanding of the principles involved in worts such as those we have been dealing with. These tests that I speak of were conducted in worts in which yeast was growing, that is fermenting, and also separately in worts in which there was no fermentation or yeast. It was done both ways because when you are dealing with the chemistry of the solutions it is desirable to get rid of the yeast, because the yeast is itself carrying on a series of chemical reactions at the same time that you are trying to test the chemical reactions, and naturally it is difficult to sort out the effects of the yeast from the effects of the pure chemistry. On the other hand, if you confined these tests to chemical tests alone, with-

out yeast, there would also be the possibility that the yeast might in some fashion alter the relations in a way which would be significant. Accordingly, the purely chemical tests were checked by putting into solutions a quantity of yeast and letting the yeast go ahead and do its work, to see whether that made any essential difference in the results otherwise obtained.

Q. 39. Did the results of these two different kinds of tests check?

A. Sufficiently so, yes. In the presence of yeast without aeration, the maximum acidity producible may increase by as much as one-tenth of a pH unit. Now, I should say that the aeration is significant because when yeast grows in a solution, the yeast itself as one of its living activities produces a gas, carbon dioxide gas, which itself has an acid reaction and may itself increase the acidity of the solution. Now, under normal conditions of yeast plant operation, that carbon dioxide gas is very largely blown out by aeration; but in order to allow for that fully, we made a test in which no aeration was conducted, and the yeast was allowed to produce its maximum concentration of this acid-forming gas in the solution. The change in the pH value under those conditions was approximately one-tenth of one pH unit.

Q. 40. Do you know the effect if any of di-ammonium phosfate in worts such as defendant's?

A. That was tested similarly to these other tests by taking a wort of the defendant's composition and adding to that wort a quantity of di-ammonium phosfate corresponding to the maximum addition that would be made to a wort in accordance with the process that you referred to in the beginning, the process specified in the answers to the interrogatories.

Di-ammonium phosfate is a yeast food. The difference between di-ammonium phosfate and mono-ammonium phosfate is that the di-ammonium phosfate con-

tains two ammonium groups combined with one phosforic acid group and the mono-ammonium phosfate contains one ammonium group combined with one phosforic acid group.

Q. 43. Did you find that the di-ammonium phosfate had any useful or substantial effect as a neutralizing agent in the worts that you examined?

A. I would not so consider it. The effect is very small. If you add to the standard wort containing the maximum quantity of sulfuric acid an amount of di-ammonium phosfate corresponding to the maximum addition in the process referred to, the reduction of acidity is approximately .1 pH unit, that is one-tenth of a pH unit. That is not sufficient in my judgment to be regarded as either useful or substantial.

Q. 44. You spoke of the maximum addition. How much was that?

A. The maximum addition of di-ammonium phosfate? That is twenty pounds, added to the fermenter. That is, our tests were made on the basis of a quantity proportional to the addition of twenty pounds to a fermenter, which is the maximum added at any one time.

I have also investigated to determine whether or not in worts such as defendant's the yeast consumes or assimilates any alcohol. I found no evidence that the yeast does consume or assimilate any alcohol in worts of the composition referred to. Alcohol was produced during the propagation period. Part of it escapes in the aeration air, is evaporated in the air used for aeration, and another part of it remains in the solution, the so-called beer left after the yeast has been removed from it. I have never seen any statement that yeast would assimilate alcohol in the presence of sugar in worts such as those we have been considering except the statement in the Hayduck Patent 1,449,105.

We made tests on the amount of yeast which may be obtained by feeding peptones and sugar in succes-

sive portions. Briefly, the nature of the tests was that essentially we repeated the process of the Rainer patent by producing a solution of peptone in accordance with that patent, also a solution of molasses, taking suitable proportions of these two solutions, innoculating the mixture with seed yeast, conducting a fermentation, additional quantities of the peptone and sugar solution being added from time to time. The quantity of yeast produced was measured, the yield was determined. Two sets of those experiments were conducted, one set at the low temperature specified in the Rainer patent, a temperature of approximately 21 degrees Centigrade, another set of similar experiments at a temperature of 28 degrees Centigrade, corresponding to modern yeast practice. In the first experiments with the low temperature the peptone was fed continuously, except, of course, for the preliminary addition to the so-called setting wort. The sugar was fed at three-hour intervals. The period of propagation was 13½ hours.

The initial dilution or concentration in terms of Balling was 1.6. As to the Ballings of the added substance I am not certain that I have that information. The peptone solution, I do not have the Balling reading on it. The peptone solution contained approximately 3 per cent. of total solids. Presumably it would have a Balling in the neighborhood of 3; but instead of measuring the Balling, which is a very inaccurate way of measuring the total salts, we measured the total solids. The molasses used was, of course, diluted for addition, and I do not find, at the moment, the Balling on that. We might perhaps have that in our laboratory notes.

The yield on the sugar in this first test, that is the percentage of the sugar, fermentable sugars, used was 140 per cent., in terms of yeast suitable for pressing. The yeast from this experiment was not, of course, actually pressed. It was measured as of the yeast that would be pressed in the factory.

Q. 58. Is that a fair method of determining yield, namely, upon the sugar content?

A. I consider it the fairest method when you are comparing different processes. It would, of course, have to be combined in a factory method with a comparison of total costs, but for the comparison of process efficiency, to measure the percentage of fermentable sugar is the fairest and most satisfactory method that I know of.

Now, in the second set of experiments we used a high temperature and the sugar was fed at one hour intervals, that is, the molasses containing the sugar. In two experiments the peptone was fed continuously and in the other experiment, to test the other alternative, all of the peptone was added at the beginning of the fermentation, there being no subsequent peptone fed. Ten hours was the period of those tests. The yields were 175 per cent., 173 per cent., and 171 per cent. upon the three parallel experiments. The percentage is the percentage of the total fermentable sugar.

I read the Rainer patent before conducting these tests. The results that I obtained, namely, from 140 to 173, corresponded approximately, as I recall, with the yield that Rainer says he obtained.

Q. 64. The Rainer patent states that from 100 kilograms of sugar there is obtained between 250 to 300 kilograms of pressed yeast. How does that correspond?

A: I think it would be difficult to interpret that exactly for two reasons: in the first place, we do not know the percentage of seed yeast used, and in the second place we don't know the amount of fermentable sugar, which may have been present in Rainer's peptone, so it would be difficult to make an exact comparison. At any rate, I would prefer not to attempt it.

In making these tests I followed what I understood to be the teachings of the Rainer patent.

MR. PHILBIN: Direct examination closed.

CROSS-EXAMINATION BY MR. WATSON:

My position on the faculty of New York University is that of a lecturer in general science, in charge of the Department of General Science. It usually includes quite a good deal of teaching. I happen, this year, to be enjoying a year of absence from teaching. Ordinarily I teach ten or twelve hours a week.

XQ. 68. In many of the questions asked during your direct examination and in many of your answers it seems to me conclusions have been included and assumptions. I think we will have to have the facts so that we can draw our own conclusions and therefore I will ask you whether you have the records showing the materials employed and the measurements taken and the readings and full data with respect to the tests that you have referred to during your direct examination.

A. Certainly.

MR. WATSON: May we have those?

MR. PHILBIN: Yes. Mr. Watson has asked that he be furnished with the detailed records of the work and tests which Dr. Free did and upon which he based his testimony. We will be glad to give to Mr. Watson that information. I might add, your Honor, and you might recall that Dr. Lamb testified in broad and general terms that he did similar work and obtained "marked and significant results," and nothing was supplied to us. However, we are entirely willing to give to Mr. Watson anything we have in the way of those statements.

MR. WATSON: I take exception to the comparison, Mr. Phibin, because I think we have given you all that you asked for.

MR. PHILBIN: No, I do not think you have given me what I asked for. Also, I asked several questions and one of them was as to how large was the vats and containers in which Dr. Lamb performed his experiments and I was refused to be given that information.

THE COURT: You did not ask for that in court.

MR. PHILBIN: No, your Honor.

MR. WATSON: The reason it is necessary for me to ask for that information that I have is that the witness says, for example, that he followed the Rainer patent. Well, that is his opinion. We must find out what he did so that the Court can judge whether he followed the Rainer patent.

MR. PHILBIN: May I suggest this, your Honor: there are a great many details and experiments and tests of a rather technical nature. We have no objection whatsoever to giving to Mr. Watson everything that is there. It occurred to me that time might be saved if we gave that material to Mr. Watson and have Dr. Free answer any questions which Mr. Watson, or his expert, might ask Dr. Free with respect to the work he has done, and then if there is anything in those experiments or tests which Mr. Watson wants to put on the record, we will be very glad to have him do so.

THE COURT: It would seem to me that that would save time, wouldn't it?

MR. WATSON: Yes, sir.

MR. PHILBIN: Because otherwise, your Honor, there is examination and cross-examination and there is a waste of time.

THE COURT: Oh, yes, it will be interminable.

MR. PHILBIN: And we will be glad to give Mr. Watson anything he wants and he can put anything he wants on the record.

THE COURT: That would indicate that if you examined this witness now you would be losing time.

MR. WATSON: I think so, although there may be a few matters that we can get in the record now, but otherwise I think it would be more expeditious to let us look at the book and that might boil down the examination.

THE COURT: Yes.

MR. PHILBIN: I might also add, your Honor, that that will conclude defendant's case, with the exception of putting in evidence a few documentary exhibits.

XQ. 69. On the tests which you spoke of as duplicating the Rainer patent, what materials did you employ to make your peptone extract?

A. The one that I specifically referred to employed sprouts, grain sprouts, and phosforic acid. I might say that other tests were made with other materials.

XQ. 70. Your records will show the amount of sprouts and acid?

A. I will be glad to tell you that now if you wish it. We have that in the record.

XQ. 71. Did you test your peptone extract for sugar content?

A. Yes, sir.

XQ. 72. What was that?

A. In the low temperature test, which I discussed a short time ago.

XQ. 73. Was not the sugar content of the extract the same in both tests?

A. Not quite. In one case it was—I am sorry, I made a mistake in that answer——

MR. WATSON: That is all right.

A. (Continuing.) In one case it was 7.45 grams per liter and in another case it was 7.80 something, 7.87, approximately, grams per liter, very nearly the same but not quite the same. So far as the sugar content in the extract is concerned you cannot determine the Balling. That is, the Balling is not determined by the sugar content alone but is determined by all of the substances present, dissolved and otherwise.

XQ. 75. Yes, I understand that. But if the other substances were not present and you merely had that concentration of sugar, what would the Balling be?

A. Approximately .7—no, I am sorry, not approximately .7, approximately 7. It would be larger. That is, the Balling in pure sugar solution corresponds approximately to the—wait a minute, we are getting this twisted. What I gave you was grams per liter——

MR. WATSON: I thought so.

THE WITNESS: Not percentage. The percentage would be 1/10 of that, that is approximately .7. Let me make that perfectly clear for the record. The amount of sugar present in the peptone, as we have used it, is between 7 and 8 grams per liter, depending on the individual sample of peptone; the grams per liter is ten times the percentage, so that the percentage of sugar is between .7 and .8. Now, in a pure solution containing nothing but sugar, the Balling would read approximately the same as the percentage figures.

XQ. 76. And what was the Balling of the peptone extracts as you used them?

A. I testified a while ago that—I don't have that in my head, and I don't find it immediately in the

figures. I am not at all sure that we determined it, as a matter of fact. I may say there is no difficulty in supplying that figure if it is considered important, because a similar solution can be made and tested for Balling, and I may say also I would like to add that the Balling scale is not, of course, used at all in scientific work because of its extreme inaccuracy. In scientific work we depend upon the actual measurement of the quantities present rather than upon the Balling scale.

XQ. 77. It is a very common measuring instrument in the yeast business, isn't it?

A. In the yeast business only.

XQ. 78. What experience have you had with the yeast business?

A. For five years I was one of the chief consultants, technical consultants, for the California Wine Association——

XQ. 80. Does that company manufacture bakers' yeast?

MR. PHILBIN: That wasn't the question, your Honor. I think he is entitled to answer the question that was asked, his experience with yeast.

A. (Continuing.) The California Wine Association, of course, produces yeast in the same way as the bakers yeast people do. I was also consultant to the California Packing Corporation, which also is involved in the yeast business, especially in the manufacture of yeast, alcohol and other products, in Hawaii. I have been consultant for, I should say offhand, perhaps half a dozen breweries manufacturing yeast and beer. I have had occasion twice to investigate the activities of the Fleischmann Yeast organization, for other clients than Fleischmann. I do not pretend to be a practical yeast maker, and I have no intention of

testifying concerning the practical manufacture of yeast in any way.

(Recess until following morning.)

Page 87 of my book of notes refers to the preparation of two batches of clarified molasses. In the clarification of molasses it is necessary to carry out an acid areatment, and a treatment with calcium phosfate or some equivalent material, that being a part of the normal process of preparing clarified molasses. In preparing the first batch we were a little uncertain as to whether the amount of acid used had been correct. Accordingly, in order to make sure that everything was satisfactory, we prepared another batch, made tests with both of them to make sure that they were all right. The pH value was not materially lower with the second batch. The curves are given here. The difference was in my judgment insignificant in the two cases. You no doubt observed this chart which gives the curves on the two batches.

XQ. 83. Well, give us the pH value of the first and second batch, please.

A. You mean the pH in the beginning or the pH at the point of maximum acidity, that we were talking about?

XQ. 84. At the end of clarification.

A. That is the pH of the molasses wort without any added acid, is that what you mean?

XQ. 85. That is right. I think they are on page 87.

A. Well, I am taking it from the curve. It may be in the data, if you would prefer. It is 4.96 in the case of molasses wort No. 1, and 5.16 in the case of molasses wort No. 2, both on the pH scale.

XQ. 85a. Thereafter in your experiments which included the use of clarified molasses, did that clarified molasses correspond to the batch No. 2?

A. No, both batches were tested; the data include tests on both batch No. 1 and batch No. 2.

There are some references in the tests to the use of clarified molasses "prepared as before." Unless the batches are specifically named, it would be prepared in accordance with batch No. 2.

XQ. 87. The clarification of batch No. 1 was conducted as the clarification of the molasses indicated on Plaintiff's Exhibit 15, is that correct?

A. I am not familiar with the exhibit. It was conducted in accordance with the defendant's process as described in the answer to the interrogatories.

In batch No. 2 I used a lesser quantity of sulfuric acid in the clarification of the molasses than in batch No. 1. Referring to page 87 of my book, this shows that in preparing the materials for the experiment there referred to I did not sour the grain by lactic acid bacteria.

XQ. 90. On page 95 of your notes there is a reference to the use of 30 cc.'s of grain wort. How does that correspond in grain content to the 20 cc.'s of grain wort referred to in table 2 of page 89 of your book?

A. Well, I presume—I would have to check this through in detail, but it presumably is the same because both were intended to represent the same quantity of material. However, I wouldn't like to answer that finally without studying the data in more detail. I don't remember the exact circumstances.

On page 94 of my book there is a reference to 3.65 grams of ammonia. That was not aqua ammonia as added to the solution. The reference states: "To one of these portions was added a 100 cc. aqueous solution containing 3.65 grams ammonia and 19.37 grams of lactic acid." That was a solution therefore of ammonium lactate made up by adding aqua ammonia to lactic acid.

XQ. 92. With no excess lactic acid?

A. It was intended to be a neutral solution of ammonium lactate.

XQ. 93. Do you know whether the buffering effectiveness of molasses depends on or is affected by the dilution of the molasses?

A. It is affected to some extent, yes, sir.

XQ. 94. And affected in the direction of lesser buffering with higher dilution?

A. I think that would in general be true. You will find in the book tests made by two other dilutions than the one specified in the defendant's answer. One is a higher dilution, one is a lower dilution. The data is in the book and I have seen it.

XQ. 95. And that data shows, does it not, what I have stated, that the buffering effectiveness is lesser——

A. Slightly so, yes, sir.

XQ. 95. (Continuing.) —when the dilution is higher?

A. Slightly so, in this instance.

XQ. 96. There is data in your notes indicating, I think, that the presence of carbon dioxide under the conditions, in the presence of sulfuric acid, raised the acidity.

A. Slightly, yes. Whether that data is in the notes or not I don't recall, but that is true.

XQ. 98. On page 94 of your note book you refer to this 100 c. c. aqueous solution containing among other things lactic acid. Where did you get that lactic acid or how did you make it?

A. The lactic acid was purchased from a chemical-supply house, I believe the Bloomfield Chemical Company, or words to that effect. It was manufactured by Merck, the well-known manufacturer of chemical materials.

XQ. 99. What was its strength?

A. That I cannot say without referring to the bottle. It may be specified in the notes. If not, the

thing which is in the notes would be the amount of actual lactic acid present in the material.

XQ. 100. Will you refer to the notes (handing to the witness)?

A. That, of course, would have to be checked up by reference to the original bottle. The general answer is that the material used was the purest lactic acid obtainable by us in the market, in concentrated form. The usual concentration is something like about 80 per cent. Of course, it must be understood that these figures refer to lactic acid, not to any solution of lactic acid. They refer to the chemical individual lactic acid.

My direct testimony referred to tests with diammonium phosfate, and my note-book contains data on these. The date isn't on the tests and accordingly, I don't know at the moment when they were performed. They were performed within the last ten days or two weeks. I can get you the exact date very quickly, if you want it.

XQ. 104. That is sufficient for my purposes, thank you. They refer, I believe, to the use of a portion of a wort taken from defendant's fermenter in commercial operation. Do you know whether that was the same as the wort used by defendant in the operations shown in the mash sheets in evidence?

A. I do not know of my own knowledge, no, but I believe that it was not, although the difference would be I think very small.

XQ. 105. Well, to the extent that it may have been different, then, you did not in those tests follow as closely as you might have the operations shown in defendant's exhibit which you purported to follow, is that the case?

A. That is correct, in that case.

XQ. 106. You say you cannot tell us, you do not know the history of the wort in defendant's commer-

cial operation of which you took a sample for that experiment?

A. I do not know that of my own knowledge. I should point out perhaps that tests were made with molasses solutions and di-ammonium phosfate, which I believe to be entirely similar to the worts specified in the defendant's answer.

XQ. 107. You are referring to the synthetic worts that you compounded?

A. Synthetic molasses solution, not necessarily a wort. That is a solution made from molasses, similar to the molasses used in the worts.

XQ. 108. That was compounded so far as clarification is concerned according to the preparation of the batch No. 2 in the prior testimony?

A. Substantially so, yes, sir.

I wouldn't care to make an accurate comparison of lactic acid and phosforic acid as to their strengths without knowing just what you meant by strength because it would depend upon the circumstances. However, in a general way, phosforic acid is stronger, usually regarded as a stronger acid than lactic acid.

They are both of them stronger than carbonic acid under ordinary conditions. I should point out that the strength of an acid really does not mean anything unless you define the circumstances under which you are measuring the strength, what you mean by strength, but in ordinary language carbonic acid is weaker than either of the others.

XQ. 112. Cannot acids be compared as to their relative strengths when considered in the same concentrations?

A. Only if the other constituents of the solution are the same. And you have to define strength as to what you mean by it, whether it is dissociated and so on.

If you take a solution of the three acids concerned in pure distilled water and if it is a dilute solution so that the dissociation is substantial, and if you mean by the strength of acid the concentration of the hydrogen ions produced in the solution, in general, at ordinary temperatures and under ordinary conditions, carbonic acid would be weaker than the others. I am sorry to have to qualify this so much; it really is necessary because of the effect of conditions on the dissociation of the acids.

XQ. 115. Will you read into the record the figures of tests 14 and 15 on page 57 of your notebook. These, I think, refer to alcohol.

A. These are the repetitions of experiments 14 and 15. Perhaps I might suggest the most convenient thing would be to put the whole page in. I would be glad to read any portion you want. These are, however, repetitions of experiments 14 and 15, not the original experiments, although they are their equivalent. We reached the same conclusion.

(Page 57 of notebook is here copied into the record as follows:)

EXPERIMENTS 14 and 15
Repeated August 9, 1935
ALCOHOL DETERMINATIONS

Experiment 14 (repeat) Grams alcohol per 100 cc.				Experiment 15 (repeat) Grams alcohol per 100 cc.			
Hrs.	Refractometer	Pycnometer	Ave.	Hrs.	Refractometer	Pycnometer	Ave.
2	0.046	0.062	0.054	2	0.069	0.074	0.072
4	0.038	0.051	0.045	4	0.120	0.112	0.116
6	0.021	0.031	0.026	6	0.107	0.099	0.103
8	0.110	0.104	0.107	8	0.203	0.197	0.200
10	0.000	0.002	0.001	10	0.062	0.066	0.064
		Experiments 14 and 15, June 18, 1935					
4	0.056	0.040	0.048	4	0.063	0.058	0.061
8	0.133	0.133	0.133	8	0.231	0.265	0.248
10	0.000	0.032	0.016	10	*0.000	0.077	0.039

*Sample was moldy when tested with refractometer.

COMPARISON OF AVERAGE RESULTS

Experiments 14 and 15 and 14 (repeat) and 15 (repeat)

Grams Alcohol per 100 cc.

	14 (repeat)	#14			15 (repeat)	#15	
Hr.	Aug. 9	June 18	Ave.	Hr.	Aug. 9	June 18	Ave.
4	0.045	0.048	0.047	4	0.116	0.061	0.089
8	0.107	0.133	0.120	8	0.200	0.248	0.224
10	0.001	0.016	0.009	10	0.064	0.039	0.052

XQ. 116. In these experiments 14 and 15 you used the same nutrient solution in the two cases except that in the case of No. 15 you added an excess load of alcohol?

A. Yes, sir. I don't have the notes before me but I believe it was experiment 15 that had the alcohol, experiment 14 which did not have it. If you want to be sure about that I will just check it and make sure. Experiment 14 had no added alcohol; experiment 15 did have added alcohol. Experiments 14 and 15 as repeated were the same. In those experiments the per cent. of seed yeast used I think was 20 per cent. of the molasses as usual.

XQ. 118. I had an idea that the book showed 8 to 12 per cent. in that. If I am wrong——

A. Well, I think not, but, of course, I might be incorrect about that. Perhaps that should be left for a more careful check of the data. The statement on the first page is that the feed used was normal, and normally the feed used was 20 per cent. of the molasses.

However, if the point is of importance, I would prefer to be allowed to check that carefully and make sure.

As to the length of the time of fermentation and the length of time of the feed in those experiments I think that is in the book, if I may have the book back. If it isn't, it can be provided.

In experiments 14 and 15 the feed was ended at the eighth hour, after the beginning of the yeast propa-

gation. The experiment concluded at the tenth hour. Those same times were followed out in the repetitions of those experiments.

XQ. 121. Now, I also called your attention to another page, the experiment which refers to the use of 4 to 6 per cent. of seed yeast. Was that normal?

A. That was not in a fermentation, that was a part of the method of preparing a molasses free from fermentable sugar. In one of the experiments we desired to try the behavior of the yeast in a synthetic solution containing alcohol and containing the non-sugary constituents of the molasses, constituents other than sugar. In order to obtain that molasses free from sugar, there being no other way to do so, we fermented some of the molasses in advance, separately, and produced thereby a molasses substantially free from fermentable sugar.

I do not know the amount, the percentage of seed yeast commercially used in defendant's operations as reflected by the mash sheets exhibits in evidence.

XQ. 124. Well, in some of these experiments that were referred to I understood you were attempting to follow as closely as you could the defendant's operations as shown in the mash sheets?

A. That is correct.

XQ. 125. Do you know whether you followed the mash sheets in respect to the amount of seed yeast employed?

A. I believe that I did. I was informed by the operators at the plant that this would be a correct percentage.

The rate of feed used in the experiments 14 and 15 was not, of course, a constant thing, because in all of these experiments it is necessary to increase the rate of feed as the experiment continues, because of the fact that there is more and more yeast in the solution as the experiment goes on. Again, those feeds are given

in detail in the data which is in the book, and I suggest, if it is significant, that all of that data might be put into the record. There is no individual, no single, rate of feed in those experiments.

Referring to my book, the feed of the molasses solution, I suppose you are interested in the molasses solution essentially, the feed of the molasses solution at the first hour was 1.25 liters. During the second hour the feed was 1.5 liters. During the third hour the feed was 1.75 liters. This is experiment 14 and 15, both. The feeds are the same. During the fourth hour the feed was 2.25 liters. During the fifth hour the feed was 3.0 liters. During the sixth hour the feed was 3.75 liters. During the seventh hour the feed was 4.50 liters. The feed ended at the end of the seventh hour, eight hours after the beginning of the experiment. There were 3600 grams of molasses in 14.4 liters of feed solution. I assume that we have the Balling, and it can be obtained for you, if you wish.

XQ. 131. How much molasses was in the fermenter at the start?

A. Two liters of the molasses solution were used to set. That is 1/7 approximately of the total quantity of molasses.

The volume of the liquid in the fermenter at the start was 96 liters.

XQ. 133. Read into the record, please, the yield at the end of the eighth hour in each of these experiments.

A. In the case of experiment 14, which was that without extra alcohol, the yield at the end of the eighth hour was 2346 grams of yeast. That corresponded to a percentage on the sugar in the molasses of 136.5, 137 approximately, per cent. In the case of experiment 15, in which alcohol also was present, the yield was 2235 grams, corresponding to a percentage of 130 per cent. on the sugar content of the molasses.

As to the yields at the conclusion of the process, at the tenth hour, after two hours without sugar feed, the yield of yeast in experiment 14 was 2441 grams, corresponding to 142 per cent. on the sugar in the molasses. At the same time in experiment 15, which did contain alcohol, the yield was 2470 grams, corresponding to 143.5, approximately 144, per cent. of the sugar in the molasses.

XQ. 136. Read into the record, please, from page 56 the same data apparently with respect to the repeat 14 and 15 experiments.

A. In experiments 14 and 15 as repeated, the net yield of yeast at the end of the eighth hour, corresponding to the end of the feed of sugar, for experiment 14 without the alcohol was 2396 grams, corresponding to 139.3 per cent. of the sugar in the molasses. In experiment 15, with the alcohol, at this same hour the net yield was the same, 2396 grams, corresponding to 139.3 per cent. of the sugar in the molasses. At the tenth hour, after two hours without sugar feed, in experiment 14, without added alcohol, the yield was 2728 grams, corresponding to 158.6 per cent. of the fermentable sugar in the molasses. At the same time, in experiment 15, with alcohol, the yield was 2830 grams, corresponding to 164.5 per cent. of the fermentable sugar in the molasses.

XQ. 137. These processes, these test processes, that you have referred to were ten hour operations, were they not?

A. Ten hour conduct of the aeration, eight hour feed.

XQ. 138. I thought you spoke a moment ago of terminating the feed at the end of the seventh hour.

A. Well, it is eight hours after the beginning, that is, the feed terminated eight hours after the thing began. Of course, there might perhaps be some confusion about which hour is the seventh and which is the

eighth, but eight hours after the beginning of the experiment, which beginning dates from the start of aeration, eight hours after that the feed was stopped and two hours later or ten hours after the beginning of aeration the aeration was stopped.

XQ. 139. In this respect you failed to follow the defendant's commercial procedure as shown in plaintiff's Exhibits 13, 14 and 15?

A. In this particular experiment there was no attempt to follow the defendant's commercial procedure in detail. We were interested in these experiments in determining the scientific fact as to whether or not yeast would consume alcohol in the presence of sugar. Accordingly, the experiments were designed to test that rather than to duplicate the defendant's process. They do in a very general way, I think, duplicate the process but not in detail.

XQ. 140. Well, on that broad objective, is it your opinion that yeast will not assimilate alcohol as long as there is sugar present?

A. That is my opinion, yes, sir.

XQ. 141. And you do not mean then to express the opinion that in a yeast manufacturing operation as conducted by the defendant shown by the exhibit mash sheets, yeast will not assimilate any small quantities of alcohol formed?

A. I would be inclined to express that opinion, yes, because it is my belief that in the defendant's process there is always at least a certain small quantity of sugar present up to the time at which the sugar feed is discontinued. However, the only thing on which I am really qualified to testify in this case is concerning the action of the yeast itself.

XQ. 142. Excuse me for interrupting, but I think you did not understand the question because you referred to the presence of sugar until the termination

of the feed. Is it not a fact that in defendant's commercial operations, as shown by these exhibits, the propagating period continues for an interval after the feed is discounted?

A. That is my understanding, yes, sir.

XQ. 143. Now you can answer my question, if you will, as to whether in your opinion yeast during propagation over this interval, after the feed has been stopped, may assimilate small quantities of alcohol, possibly formed up until that time?

A. That is my opinion, yes, sir; if it happens in the defendant's process that after the cessation of feed of sugar the sugar remaining in the solution is exhausted, then in my opinion it is possible that the yeast would absorb and assimilate some of the alcohol which had previously been produced and was still present in the solution.

XQ. 144-5. And I take it that your opinion in that respect is not confined merely to the operations shown in these mash sheets but to all similar operations where yeast propagation is continued over an interval say of 15 hours, although the regulated in-feed of the more concentrated sugar reserve ceases before the end of the fermenting period, before the end of the propagation?

A. That would depend upon whether there is sugar left in the solution. Perhaps I can make my opinion clear by a general statement: In the presence of fermentable sugar, in my opinion yeast will not absorb alcohol or assimilate it, alcohol being a normal discharge product, excretion product of the yeast. In the absence of fermentable sugar or other easily available carbohydrate foods which the yeast prefers to use, prefers to eat, it is my opinion that yeast will, under suitable conditions, assimilate alcohol as being the best food available. In other words, if the yeast is well fed

it will not eat alcohol; if it is starved, in my judgment, it may eat alcohol.

XQ. 146. Can you express an opinion as to the operations such as shown by the Mash Sheets Exhibits 13, 14 and 15, as to whether or not yeast may assimilate alcohol during the period after the feed has terminated?

A. Qualifying my opinion by the statement that I am, of course, not testifying as a practical yeast operator, it is my opinion that the sugar would tend to be exhausted during that period subsequent to the stoppage of feed and that if it were exhausted the yeast would tend to consume any alcohol present in the solution.

XQ. 147. Refer to your notes of experiments 5 and 6, if you will. What was the object of those experiments as indicated by the heading in your notes?

A. Those experiments were originally planned to determine the absorption of alcohol by the yeast. The experiments were planned wrongly, for which I take responsibility. They did not show anything of significance, and accordingly a new set of better experiments, properly planned, were performed afterwards. The heading in the notes is "Memorandum on Experiments 5 and 6—Made June 6, 1935."

XQ. 149. Perhaps that isn't the right one. There is another one there somewhere. It is the introductory sentence that I was interested in, which reads, "These experiments were made to discover whether a normal yield of yeast would be obtained when part of the sugar in a salts-molasses wort is substituted by alcohol. . . ." Now, referring to those experiments, will you tell us how much alcohol was substituted for molasses, in one of them?

A. Without checking up the data, my recollection is that 25 per cent. of the molasses was replaced with alcohol in one of the experiments.

XQ. 150. And read in the record, please, the yeast yields obtained in the two tests.

A. In one experiment the yield was 2399 grams. In the other experiment, 2360 grams. In the first the percentage on the sugar used, was 137.6. In the second one it was 135.6. Of course, I want to add that these experiments were regarded as unsatisfactory and were rejected, as is covered in the notes, because of the fact that we failed to make a measurement of the yeast yield at the end of the sugar feed, and we permitted to happen in these experiments exactly what I described a moment ago, namely, that after the end of the sugar feed, when no sugar was present in the solution, the yeast was allowed to go ahead and use up anything else left, including the alcohol; and I am quite willing to state that in these experiments I believe that the yeast did use the alcohol during the last hours of the experiment. At that time the sugar was actually exhausted in these particular experiments.

XQ. 152. Did you ever repeat that experiment, taking the yields at the eighth hour?

A. We did, yes. Those are the experiments 14 and 15 I testified to a moment ago.

XQ. 154. In tests 14 and 15 did you substitute alcohol for molasses?

A. No. We added alcohol——

XQ. 155. I ask you if you ever repeated the tests for 5 and 6 taking the yeast yields at the eighth hour as well as the tenth?

A. I should have said that we repeated what we considered to be an equivalent experiment. Of course, no two experiments are ever exactly alike, or very seldom so.

XQ. 156. Well, it would have been easy to repeat those experiments, would it not, so far as substituting alcohol for molasses is concerned?

A. Quite, but it was to our mind better and more significant to do it the other way.

XQ. 157. On page 262 of the record you referred to one of the tests and stated: "Accordingly, the purely chemical tests were checked by putting into solutions a quantity of yeast and letting the yeast go ahead and do its work." What did you mean by letting the yeast do its work?

A. Letting the yeast carry out a fermentation of the sugar present in the solution. That is a conversion of that sugar in part into alcohol and carbon dioxide gas.

XQ. 158. Do I understand by that that you merely put the yeast in the solution and let it ferment until it was saturated with carbon dioxide?

A. Yes, sir.

XQ. 159. Now, will you refer to your note-book and select any of the tests for which data is given with regard to what you have called a duplication of Rainer, select any one of those which you think is typical of your experimental work on that subject, please?

A. It will be necessary I am afraid to select two experiments, one at the low temperature specified in Rainer itself, and another at the higher temperature, which is now customary in the business. For the low-temperature experiment we can select, for example, the repetition of experiment 10, which begins on page 40 of the note-book. For the high-temperature experiment we can select the repetition of experiment 1, which also begins on page 40 of the notebook. Those two experiments were carried out in parallel.

XQ. 160. Now, referring to the repetition of experiment 10, it has been testified in the case that the Rainer patent shows two alternative procedures. Was this repetition of test 10 the first Rainer procedure or the second, do you know?

A. It was neither, because it is not my opinion that there are two alternative procedures in the patent. It was a repetition of the Rainer patent, the Rainer process, using the raw materials specified by Rainer, and observing one teaching regarded by me as essential, namely, that the sugar concentration in the Rainer patent, Rainer process, should be kept low, and that additional sugar should be supplied as the initial sugar is consumed by the yeast. I don't mean to imply that that is the correct interpretation of the patent; it is the interpretation which I reached.

MR. WATSON: I understand; and while we are on that subject, I should mention what I have failed to do, which I took for granted, that Mr. Philbin was not offering two patent experts in the case, that this witness is merely a fact witness, dealing with what he did, following what he thought.

MR. PHILBIN: That is correct.

XQ. 161. Now, referring to this repetition of experiment 10, can you tell me whether in making that you attempted to follow the Rainer disclosure of procedure through the specification preceding the third paragraph from the end of the specification, the words commencing, "In order to obtain a yeast as pure as possible," or whether you attempted to follow the procedure of that third paragraph from the end, commencing as I have just quoted?

A. That he should follow in order to procure a yeast as pure as possible—no, we didn't attempt to follow that specification in detail. What we attempted to do is to start out with the ratio of peptone and sugar which Rainer teaches.

XQ. 163. You haven't answered my question. The question is, did you attempt to follow the specification preceding that paragraph?

A. No, we didn't attempt to follow either one in detail.

XQ. 164. Now, taking your repetition of test No. 10, will you please describe that test in some detail as to the materials employed, the raw materials you started with, what you did with them, how much of them you employed, what procedure you followed and what yeast yields you obtained? I want on the record merely a connected statement of what you did in that experiment and I think you could make it in more compact form on the record than we can get it from the actual notes.

A. The Rainer process involves two raw materials.

XQ. 165. The answer will be simplified also if for the moment you just disregard Rainer and confine yourself to what you did as to materials, etc.

A. There were two raw materials concerned with the material to put into the fermenter, a solution of grain or similar substance, which is commonly called peptone, and a solution of molasses. Those, of course, were prepared separately. Approximately 30 pounds of malt sprouts was mixed with approximately 148 liters of water. To that there was added 425 grams of phosforic acid, 85 per cent. strength. These figures should not be taken as absolutely accurate, they are approximate figures, with perhaps a variation of 5 per cent. or 2 per cent., something like that. This mixture of malt sprouts, water and phosforic acid was heated to 59 degrees Centigrade, cooled to room temperature, heated again for purposes of sterilization, and that provided the peptone solution.

XQ. 166. Give us the period of heating and the period of cooling, if you can.

A. Well, the liquid was allowed to cool as it did cool. I don't know that we can tell you just how long that was, we don't have that in the memorandum I have here. If it is important, I will try to look it up.

XQ. 167. I thought the notebook said 21 hours.

A. Well, it was 21 hours—the 21 hours, I imagine, refers to the whole process of heating and cooling, but I can have that confirmed if it is considered significant. Now, that solution obtained in that way by the digesting of malt sprouts with phosforic acid and water constituted the peptone solution used in the experiments. I should explain that in the course of the experiments four such peptone solutions were made, all made in the same way except for such variations as are unavoidable in using a material such as malt sprouts. The other solution was made by taking 9600 grams of raw molasses, raw beet molasses. With that there was mixed approximately 29 grams of calcium acid phosfate.

XQ. 168. With the molasses?

A. With the molasses—48 grams of concentrated sulfuric acid, ordinary laboratory acid, and approximately 10 liters of water. That mixture was heated to approximately 90 degrees Centigrade and allowed to settle, clarifying it by settling. The clear solution drawn off from the settled material was then used as the molasses solution for each of the runs concerned. Now, in experiment 10 or the repetition of experiment 10, which were in exact duplicate, 3215 grams—this is in the duplicate of experiment 10—3215 grams of molasses was used; 521 grams of that molasses or a quantity of solution containing that much molasses was placed in the fermenter for the beginning of the experimentation.

XQ. 169. What was the quantity of the solution?

A. Well, that I would have to compute for you. It is the quantity corresponding in accordance with the figures you already have, corresponding to 521 grams. Do you want me to stop and compute it?

XQ. 170. No, I mean the quantity of the solution in the fermenter.

A. The total volume at the setting was 96 liters.

Mr. Philbin: May it please the Court, we gave at the close of the testimony yesterday to plaintiff's counsel the book containing the records of Dr. Free's work concerning which he testified and also since that time have had Dr. Free available to answer any questions which plaintiff's counsel have asked. They have asked some, we have given that information. It occurs to me that the time of the Court might be saved and the record perhaps made less voluminous if instead of putting all this material on the record the suggestion be followed that I made yesterday that Mr. Watson, plaintiff's counsel prepare any statement that he wishes regarding any of these facts, with the co-operation of Dr. Free, and then we can put that in the record in simplified form. I don't see what we gain by doing it this way.

The Court: Why not have it marked the record is an exhibit?

Mr. Philbin: Yes, your Honor.

The Court: Then you have it all in.

Mr. Watson: The notebook itself is not in a form which is useful to counsel or could be explained to the Court in many respects, and the last question asked the witness on direct examination was: "In making these tests (of Rainer) did you follow what you understood to be the teachings of the Rainer patent?

"A. Yes, sir."

Now, I want to inquire of the witness exactly what he did in this test so that later we can draw our own conclusions as to his comparison.

THE COURT: There is testimony, I believe, to the effect that there was but one process in that patent and other testimony that there are two.

MR. WATSON: Dr. Rautenstrauch said there were two.

MR. PHILBIN: But my suggestion is, your Honor, why can we not do exactly what Mr. Watson wants done in a simpler and quicker way, namely, by getting any information that he wants and putting it in the record?

THE COURT: He says the difficulty is that the notebook concerning the testimony which he is now obtaining is not sufficient.

MR. WATSON: It won't take long to have a connected story of what the witness did in this experiment.

THE COURT: In view of that, just confine yourself to making up what you consider necessary to make this notebook intelligible; then offer the notebook as an exhibit, and then you have it for reference. Why wouldn't that be well to do?

MR. WATSON: We got the notebook when we adjourned last evening but there is so much material in it pertinent to so many different subjects that really we haven't ourselves had an opportunity to go over it with sufficient detail.

THE COURT: In other words, you don't want in evidence here any part of that notebook other than what you yourself understand?

MR. WATSON: Yes, that is correct. The defendant has not offered it and we don't want to encumber the record with anything more than the mini-

mum which we require. I think if we can proceed we will get the witness' story very quickly of just what he did on this test. That is what I want to know.

MR. PHILBIN: We have no objection to that, your Honor, and it does seem to me that Dr. Free can tell Mr. Watson off the record and in informal questions everything that Mr. Watson wants to know and he can put that in any sort of a story, any sort of a statement that Mr. Watson wishes, and that can be put in the record in that form to the satisfaction of Mr. Watson.

MR. WATSON: If Mr. Philbin is suggesting that we take an hour's adjournment to have the witness dictate a statement, that's all right with me.

MR. PHILBIN: I am not suggesting anything, your Honor, except that it does seem to me that doing it this way——

THE COURT: Well, will you shorten it as much as you can, Mr. Watson?

MR. WATSON: Surely.

(At this point a short recess was taken.)

XQ. 170. Will you continue?

A. I believe in my discussion of experiment 10 I had got as far as the starting of the fermentation, yeast propagation in the fermenter. Ninety-six liters of solution was used to start the fermentation. In that there were 521 grams of the molasses and an amount of the peptone solution corresponding to 492 grams of the dry matter, the dry substance in that solution. To this there was added 267 grams of seed yeast, actually Fleischmann commercial yeast purchased on the market. The experiment was started, aeration air was

run through, the run was continued for 13½ hours at a temperature of approximately 21.3 Centigrade, variation being plus or minus about .1 of a degree. The yeast made, the net yeast made, was 2114 grams, corresponding to 137 per cent. on the fermentable sugar used. In the repetition of the experiment, otherwise similar, the yeast made was 2199 grams, corresponding to 162 per cent. of the fermentable sugar used. The amount of molasses used in the repetition of experiment 10 was slightly less than in the original experiment, being 2836 grams. The yeast obtained was tested for protein percentage, baking test and so on, and was found to be normal. That is the experiment at the low temperature.

XQ. 171. Did the 96 liters of solution that was used to start the fermentation represent the total solution at the beginning? That is, include both the 521 grams of molasses and the peptone?

A. Yes, sir. The amount, the necessary amount of molasses solution and peptone solution was put in the fermenter, and that was diluted with water to a total volume of 96 liters.

XQ. 172. I didn't understand your answer to include a reference to the materials fed into the fermenter during the 13½-hour period.

A. The difference between the amount of peptone and sugar, which I stated as used to set, represents the amount fed in through that period. If you would like the feed given in detail, we can give it to you.

XQ. 173. If you please. I want the feed of both the molasses and the peptone, and the times when the additions were made.

A. Well, taking the molasses first, the total quantity of molasses fed as distinct from that used to set was 2694 grams. That was fed at three-hour intervals. That is, at the third hour there was fed 1.75 liters of the molasses solution. At the sixth hour there was fed

2 liters of the molasses solution. At the ninth hour there was fed 3 liters of the molasses solution. At the twelfth hour there was fed 2 liters of the molasses solution. The peptone fed as distinct from the peptone used to set was equivalent to 368 grams of total solids. The peptone was fed continuously at a continually increasing—no, I am sorry; it was fed continuously at the rate of 1.5 liters of solution during the first eleven hours of the experiment. That was a constant rate in that particular experiment, 1.5 liters per hour.

XQ. 176. How much peptone on a dry-weight basis did you obtain from the 30 pounds of malt sprouts that you used as raw material?

A. I don't have that figure in grams, but the ratio of the sprouts used to the dissolved peptone obtained was 3.09, in the solution used for experiment 10, and 2.96 in the solution used in experiment 10 repeated. That is, approximately 30 per cent. of the sprouts used were obtained as total solids in the peptone.

XQ. 177. Do you mean that in this test No. 10 you used in the fermenter all of the peptone material obtained from the thirty pounds of malt sprouts?

A. No, sir. No, sir. You asked me the percentage of total solids obtained in the peptone from the sprouts or the amount.

XQ. 178. I am asking you how much peptone you obtained from thirty pounds of malt sprouts.

A. I have the ratio but not the amount. That can be computed for you, if you wish. The ratio is approximately 3. That is, approximately one-third of the sprouts were obtained as total solids in the peptone. Now, then, the proportion of sprouts corresponding to the peptone fed—I can give you the computed percentage of sprouts, the computed amount of sprouts, that would correspond to the peptone fed, and that is

2657 grams. That, of course, is computed from the total solids fed rather than being measured, because not all of the peptone solution was fed or used in the experiment.

XQ. 179. Well, have you any data from which you can give us the figure of the amount of peptone you obtained from the raw material sprouts?

A. Well, that is one-third. That is, the total solids in the peptone is one-third of the weight of the sprouts, approximately. The ratio in one experiment was 3.09, and in the other it was 2.96. I obtained approximately ten pounds of peptone, dry weight, from thirty pounds of malt sprouts.

XQ. 181. What was the Balling of the molasses solution fed in during the propagating period?

A. I am afraid we will have to get that for you; we didn't usually keep the Ballings on these things. I will have it looked up for you.

XQ. 182. And can you give us the Balling now or at the same time of the peptone solution fed in?

A. That Balling in that case was 4.05; it was one of the items I looked up for you last night.

XQ. 183. And have you the figure of percentage of sugar in that peptone solution?

A. I don't think we have it on that peptone, it was on other samples which were similar, approximately 7.5 per cent. Presumably it would be quite close to that in this instance. I am sorry that isn't the percentage, it is 7.5 grams per liter, which would be .75 per cent. That is the per cent. on the weight of the liquid solution.

XQ. 185. Can you give us the degrees centigrade corresponding to 50 degrees Reaumur?

A. 21.3 is approximately corresponding. This experiment was run between 21.2 and 21.4. That corresponds to 17 degrees Reaumur.

XQ. 186. Well, I am asking for the centigrade temperature which corresponds to 30 degrees Reaumur scale.

A. Well, I will tell you in just a second, I have to figure that out. That is 37.5 centigrade.

XQ. 189. Do your books show the yeast yields on the peptone used?

A. No, we haven't computed that—that is, you mean as a percentage of the peptone used?

XQ. 190. Yes. Do they show the yields on percentage basis of the entire raw materials employed?

A. Yes. We have computed that, not on the peptone alone but on the entire raw materials in——

XQ. 191. The raw materials including malt sprouts and all the rest of them?

A. Including all materials except water. The yield is 41 per cent. My notes show the peptone sugar ratio of the materials initially in the fermenter before propagation begins as two of peptone to one of sugar.

They do not show separately the ratio of materials fed in during the propagation. We can obtain that, we have the ratio of the total peptone used to the total sugar used, which is one to two. That is the entire amount of peptone and the entire amount of sugar used in the whole propagation—used in the sense that either at the start or in the feed it got into the fermenter. That ratio is two to one, that is, two of sugar to one of peptone. Let me clarify that: the material used to set, to start, has a peptone-sugar ratio of two to one. The total material used during the entire propagation, including the set and the feed, has a ratio, has a peptone-sugar ratio of one to two.

I made no analysis of the spent wort. I did make an analysis of the yeast obtained, for protein. The protein is 51 per cent.; 47 per cent. in experiment 10 and 51 per cent. in experiment 10 repeated.

In my repetition of experiment 1 at higher temperatures, I believe there was no significant difference in the materials. There was one significant difference

in procedure, aside from the temperature, and that was that the feed of sugar was at one hour, as I testified yesterday, instead of the three hours. The preparation of the materials was, I believe, not significantly different.

XQ. 203. In that difference what was the amount of sugar fed in at the hourly intervals?

A. In experiment 1?

XQ. 204. Yes, experiment 1 repeated, I think.

A. Well, in experiment 1 repeated the sugar feed was the same as in experiment 1 for the molasses solution. At the end of the first hour one-quarter liter was fed; at the end of the second hour .35 liters was fed; at the end of the third hour .45 liters was fed; at the fourth hour .65; at the fifth hour .75; at the sixth hour .85; at the seventh hour .95; at the eighth hour 1 liter; and at the ninth hour 1 liter. That feed schedule was the same for the repetition of that experiment.

The concentration of the molasses solution fed in was the same as during my repetition of No. 10.

The total volume of the solution initially in the fermenter was the same; I believe that all other conditions, all other essential conditions were the same.

The yield on this repetition of experiment 1 on the basis of the total fermentable sugar present was 173 per cent. The yield on the basis of the total raw materials used was 53 per cent.

XQ. 208. I think I failed to ask you, Dr. Free, with respect to your experiments 14 and 15. Those were the alcohol experiments——

THE COURT: Well, one was with alcohol and the other without.

MR. WATSON: Yes.

THE COURT: Is that correct?

THE WITNESS: That is correct; yes, sir.

XQ. 208. (Continuing.) —how you recaptured the alcohol, which was driven off on account of the aeration.

A. We didn't do it that way. I wish we could have thought of some method of doing that. As an alternative, we made a blank experiment, or a series of blank experiments, in which the same concentrations of alcohol and so forth were put in the fermenter, but there was no yeast, and then we blew those blank experiments in the same way, aerated them in the same way as the other cases, determined the amount of alcohol removed by the aeration, used it in that way. I am not acquainted with any method by which it would be possible to catch the alcohol taken away in the aeration air. Therefore, it was necessary to do it in this indirect fashion.

MR. WATSON: That is all.

RE-DIRECT EXAMINATION BY MR. PHILBIN:

RDQ. 209. Did you sour the grain with lactic acid bacteria in any of these experiments concerning which you have testified?

A. I don't think so. The grain, of course, was not soured in any of the Rainer experiments, and I don't recall testifying to any experiment in which we did sour the grain. We did not in any of the Rainer experiments which have been chiefly discussed, because in the case of the Rainer patent the sour mash process is not involved, and so far as I recall I have not testified to any experiment in which souring was employed.

These fermenter tanks in which we conducted some of these experiments were approximately 130 liters. The total amount of solution in the experiments was in the neighborhood of 110 to 120 liters in the tank at the end of the experiment. That is about the size of an ordinary barrel, perhaps a little larger, say two or three washtubs.

I was asked about the buffering effect of molasses in solutions of high dilution and in solutions of low dilution, as shown in the reports of our experiments. There was no practical difference with respect to the buffering action in the solutions of those different dilutions, at least I would consider the differences of no significance. As to the percentage values, at the point of maximum acidity the difference due to a 50 per cent. increase in dilution is about .2 on the pH scale. The difference due to dilution is smaller than that at lesser acidities. That is in one particular test. So that the greatest difference that might be made by dilution would be very much less than the variations that would be encountered in ordinary commercial manufacturing. The 50 per cent. dilution is, of course, a much greater dilution than one which ordinarily would be encountered. The variations in concentration of the wo[illegible] would probably be normally about 5 per cent. or possibly 10 per cent. of the dilution, instead of 50 per cent.

RDQ. 216. Do you understand that in the commercial manufacture of yeast on a large scale, such as in the processes we have been discussing, it is necessary to have any mathematical accuracy with respect to the proportions used, or is there a fairly wide tolerance?

MR. WATSON: If the Court please, that is a question directed to expert opinion testimony. The witness has already disclaimed his ability as an expert in the yeast manufacturing art.

MR. PHILBIN: As I recall the witness' testimony, your Honor, he said that he was a consultant of many concerns that manufacture yeast.

THE COURT: Well, there is no question but that this witness is apparently qualified. That isn't the point raised. As I understood it, you

said that this witness was to testify to nothing except experiments by him carried out.

MR. PHILBIN: Yes, your Honor.

THE COURT: Now, you are going off into the field of expert testimony. If it is objected to upon that ground, I will allow counsel to cross-examine for the purpose of ascertaining whether the witness is qualified.

MR. WATSON: I note that the witness has already stated on the record "I do not pretend to be a practical yeast maker and I have no intention of testifying concerning the practical manufacture of yeast in any way." I think that disposes of it.

MR. PHILBIN: You will also recall that the witness testified that for five years he was one of the chief consultants, technical——

THE COURT: Yes, but not as a practical yeast maker. There is no question but that he from the chemistry standpoint is qualified to my mind.

MR. PHILBIN: He was consultant, was a consultant for the California Wine Association, which uses yeast in the same way as the bakers' yeast people do. He was a consultant to the California Packing Corporation, which is also involved in the yeast business, especially in the manufacture of yeast. He was consultant for perhaps half a dozen breweries which manufacture yeast and beer. He has had occasion twice to investigate the activities of the Fleischmann Yeast Company, for other people.

(RDQ. 216 repeated by the reporter as follows:

"Do you understand that in the commercial manufacture of yeast on a large scale such as in the processes we have been discussing it is neces-

sary to have any mathematical accuracy with respect to the proportions used or is there a fairly wide tolerance?")

MR. WATSON: Now, I object on the further ground, if the Court please, that the question talked about commercial practices such as defendant uses and the witness has disclaimed knowledge of the operations of the defendant.

MR. PHILBIN: I will withdraw the question, your Honor. It seemed to me that it answered itself.

THE COURT: I think it has been answered by some witness, that a reasonable tolerance is allowed.

MR. PHILBIN: Yes, your Honor. Is there any dispute about that, Mr. Watson?

MR. WATSON: There may be a dispute as to how much——

MR. PHILBIN: Oh, yes.

MR. WATSON: Variation occurs in practice.

THE COURT: A witness, as I understand it, one of the prior witnesses, said in effect that it did not have to be mathematically certain.

MR. WATSON: I don't contend, Mr. Philbin, that in commercial operations where they are using 50,000 gallon tanks that they measure to a tenth of a cc. or anything of that kind. Of course, they work on a factory scale.

THE COURT: I think that was the expression the witness used, that they work on a manufacturing scale with tolerance.

MR. PHILBIN: Thousands of pounds of these materials are poured in, your Honor, as the tes-

timony shows. It would be commercially impracticable to have any great accuracy with respect to the proportions.

THE COURT: All right.

MR. WATSON: On the other hand, I don't want Mr. Philbin to leave the Court with the impression that in commercial factory operations there aren't certain items in procedure about which very accurate measurements are taken.

MR. PHILBIN: Such as——.

MR. WATSON: Such as acidity.

MR. PHILBIN: And that, of course, also has some range, your Honor.

THE WITNESS: I was asked about whether the presence of carbon dioxide in the presence of sulfuric acid would increase acidity and my answer was yes. Carbon dioxide would increase acidity whether or not there was any sulfuric acid present. Carbon dioxide combines with water chemically to form a loose weak acid, carbonic acid, which exists only in solution. That at least is the usual way of explaining it, so that carbon dioxide dissolved in water increases the free hydrogen ions in the water. That is true of worts or solutions such as those I have testified to, except for the buffering capacity of the wort.

RDQ. 220. Is there any necessary relation whatsoever between the creation of acidity by carbon dioxide and the presence of sulfuric acid?

A. The amount of acidity created might be affected because the dissociation of the hydrogen ions created by the carbon dioxide would be affected by the hydrogen ions already present in the solution. There is a complicated equilibrium. So that if sulfuric acid were already in solution the percentage effectiveness, so to

speak, of carbon dioxide might be changed. However, the addition of carbon dioxide always would tend to increase the acidity, much or little, depending upon circumstances.

RDQ. 221. You were asked some questions about what carbonic acid and phosforic acid, sulfuric acid and I think lactic acid might do in pure distilled water. Is yeast manufactured in pure distilled water?

A. Not to my knowledge.

My judgment is that sulfuric acid is potentially more dangerous than the others of these various acids in proportion to concentration.

Yeast will consume lactic acid in the absence of sugar and probably to some extent in the presence of sugar.

RDQ. 224. You were asked regarding the Rainer patent and I believe it was said that some witness had testified that there were two processes in that patent. I find in the record that the defendant's witness, Dr. Rautenstrauch, testified as follows: On cross-examination, page 220: "In your opinion does this Rainer patent disclose down to the beginning of the third paragraph preceding the claims one procedure and in that third paragraph preceding the claims discloses a second or an alternative procedure?

"A. That is my understanding."

And you testified that you understood the Rainer patent to disclose broadly one process. Do you still consider it discloses one broad process?

A. I do, yes. I may say I don't see any discrepancy between this testimony which I did not hear and my own.

RDQ. 225. But there are two specific examples given in the Rainer patent?

A. Yes, two variations; I would scarcely call them separate specific examples. They are two procedures. I entirely agree with the statement you just read.

RDQ. 226. In these Rainer experiments that you conducted did you prepare the peptones, the grains, in accordance with the instructions of the Rainer patent as you understood them?

MR. WATSON: Well, now, if the Court please, the witness has stated what he did. Is it necessary to ask the question?

RDQ. 227. Second, did you use a peptone ratio in the beginning of two to one?

A. Yes, sir.

RDQ. 228. Peptone to sugar ratio of two to one. Was the total amount of peptones consumed during the process with respect to the total amount of sugar used during the process of the ratio of one peptone to two sugar?

A. Approximately so. Of course; what happened to the peptone we cannot be sure of, whether it was consumed, but the peptone added and presumably consumed was in that ratio.

RDQ. 229. Third, did you feed the sugar at intervals in one case hour intervals and in the other case at three-hour intervals?

A. Yes, sir.

We supplied the peptone either all at one time or continuously during the process. We maintained a low sugar concentration in the fermenting vat during the propagation.

MR. PHILBIN: That is all.

RE-CROSS-EXAMINATION BY MR. WATSON:

THE WITNESS: We analyzed the solution in the fermenter from time to time for sugar content. As to the method used, a sample of the solution in the fermenter was taken away, taken off, a small sample, mixed with a clarifying material, "filter cel," filtered, treated with lead acetate solution to remove substances interfering with the later reaction; the final solution thus

clarified and prepared was tested for its sugar content by the method of reduction of ammoniacal copper solution, in accordance with the standard methods.

RXQ. 234. How long did such a test require, do you know?

A. Well, the whole procedure, probably on the average two days. Of course, the solutions frequently stood during that period. That procedure probably could be carried out, if you pushed it, within a matter of three or four hours.

RXQ. 235. You were asked for the peptone sugar ratio consumed by the yeast. The only basis for your answer, as I understand it, was on an assumption that you put in the solution——

A. I didn't answer the question as to consumption. I said that the peptone used, the peptone added, the total peptone added by us, was in that ratio. I have no information as to what proportion was consumed. I may say I believe that it was most all consumed, but I didn't testify as to that.

RXQ. 236. You want your final position on that point to be that you did not analyze the spent beer, or make other tests that would have been required to find out the ratio of peptone to sugar actually assimilated by the yeast?

A. Correct as distinguished from that which we fed into the fermenter.

RXQ. 238. On your repetition of the Rainer operations, which you spoke of as conducted in, I think, about the size of a barrel——

A. Approximately.

RXQ. 238. (Continuing.) Can you give us the height and diameter of the fermenter you used?

A. Not exactly. Approximately 2 feet high by 2 feet in diameter. Maybe a little larger than that. I can get that for you exactly, if you want it.

RXQ. 240. Well, approximately is sufficient for my purposes, if you think it was closely within that range. How was the air distributed?

A. Air was blown into the fermenter through pipes in the bottom of the fermenter, perforated pipes, in the fashion usual in growing commercial yeast; that is, a network of pipes, a grid of pipes, is laid in the bottom of the fermenter, compressed air is blown into those pipes, and comes out through holes in the pipes.

RXQ. 241. One coiled pipe or several crossing straight pipes, do you know?

A. My recollection is that it was a crossing grid of pipes, but that again we would have to confirm.

RXQ. 242. On your re-direct examination you were asked about the assimilability of lactic acid by the yeast. Did you make any test to determine how lactic acid compared in this respect with alcohol?

A. I have not made any tests recently, none that are involved in this data. I have made tests in the past.

Lactic acid is used more readily than alcohol. Just exactly what the ratio of use is I am not able to say without going back to that earlier data.

RXQ. 243. When was that test made?

A. Oh, that is fifteen years ago, or thereabouts. I would have to refer back to our notes. That was made, I may say, in connection with a theoretical research of the influence of substances on yeast, in the laboratory rather than in the plant.

RXQ. 244. Were the results published?

A. I believe they were, in the bulletin of Johns Hopkins University, although I would have to look that up to be sure. I may say that it is well known in the literature that lactic acid is assimilable by yeast, and it is the common opinion that it is more easily assimilable than alcohol. I don't think there is anything in

any way remarkable about my experiments in that connection.

RXQ. 245. Do you think that that publication, if there was a publication, was under your name?

A. It would be at least under my name, either alone or jointly. If you were interested I would be glad to describe the full circumstances to you.

RXQ. 246. Oh, I think it is unnecessary to cumber the record to that extent.

MR. WATSON: That is all.

RE-DIRECT EXAMINATION BY MR. PHILBIN:

RDQ. 247. You said, Doctor, that the Balling scale was used, in so far as you knew, only in the yeast manufacturing. The Balling scale is the scale to measure dilution or concentration, as I understand it. What other scales are used of methods?

A. Well, the sugar industry uses the so-called Brix scale a good deal, which is similar to the Balling scale, but gradually there is a replacement in all industries of the older arbitrary scales by either a measurement of density, as such, in terms of water, or by some other measurement, such as the grams per liter of material, or something of that kind.

RDQ. 248. You spoke about some alcohol experiments that you had made for the purpose of determining whether a yeast would consume alcohol in the presence of sugar, and you expressed the conclusion that it would not. Is that opinion of yours based only upon those experiments?

A. No, I wouldn't say so. The general physiology of yeast, the knowledge of previous experiments, indicates that it would be exceedingly unlikely that yeast would ever consume alcohol in the presence of a more favorable food, such as sugar. Also I am not acquainted with any experimental evidence or statements

in the literature to the effect that it would. Before I made these experiments it was my opinion that it was exceedingly unlikely that yeast would absorb alcohol. However, the experiments confirmed that opinion.

RDQ. 249-50. Had you ever conducted any experiment before which involved a possible consumption of alcohol by yeast in the presence of sugar?

A. Yes, I have performed many experiments which might have involved that, although the experiments were not specifically directed to that purpose, that question.

RDQ. 251. And, as I understand it, you have never seen any evidence, or read any evidence, that yeast will consume alcohol when there is available to the yeast sugar?

A. I have never seen any evidence to that effect. There is a statement to that effect in the Hayduck patent. That is the only statement that I remember ever having seen.

MR. PHILBIN: That is all.

RE-CROSS-EXAMINATION BY MR. WATSON:

RXQ. 253. Only one question: Is the conclusion you expressed as to the non-assimilability of alcohol in the presence of sugar based to any extent upon the tests 14 and 15 which you have described here?

A. Yes, sir.

MR. WATSON: That is all.

MR. PHILBIN: That is all.

MR. PHILBIN: Defendant offers in evidence as Defendant's Exhibit D-4 the book containing the records concerning which Dr. Free testified and which were shown to plaintiff's counsel. This book contains reports of experiments 3 and 4 made May 21, 1935, concerning which Dr. Free did not testify but which plaintiff's counsel asked to look

at and which we gave to plaintiff's counsel. I do not care whether they are in the book or not.

MR. WATSON: I say that they might better be out, to save us space. We looked at them two minutes, because experiment 5 had a note that it was made like 4. So we wanted to see what 4 was.

MR. PHILBIN: We will omit them. We will take them out.

THE COURT: All right.

(Received in evidence and marked Exhibit D-4.)

MR. PHILBIN: Defendant offers as Defendant's Exhibit D-5 a certified copy of German application as filed on March 15, 1915, together with translation, that corresponding, in some respects, at least, to the Hayduck Patent '103 in suit.

(Received in evidence and marked Exhibit D-5.)

MR. PHILBIN: Defendant offers as Defendant's Exhibit D-6, a copy of German Patent No. 300,662, issued November 12, 1919, together with translation, which corresponds, at least in some respects, to the Hayduck Patent '105.

(Received in evidence and marked Exhibit D-6.)

MR. WATSON: Is that the patent as issued as distinguished from the application filed?

MR. PHILBIN: Yes.

Defendant offers in evidence as Defendant's Exhibits 7 (1), (2), (3) and (4), synopses of file wrapper contents of the Hayduck patents in suit, '103, '105, '106 and '109. I will state that the complete file wrappers are also in evidence, but

the synopses are in more convenient form, I believe, to be looked at. I will be glad to have them checked by plaintiff's counsel if there is any question about their being correct synopses.

(Received in evidence as Exhibits D-7 (1), (2), (3) and (4).)

MR. PHILBIN: Defendant offers in evidence as Defendant's Exhibits D-8 (1), (2), (3) and (4), copies of the patents which were originally in this suit and which have been omitted from the present trial by plaintiff; namely, Nilsson and Harrison 1,449,127, 1,449,134, Wohl 1,475,215 and Ransohoff 1,688,831.

(Received in evidence and marked Exhibits D-8 (1), (2), (3) and (4).)

MR. PHILBIN: The witness Dr. Rautenstrauch was asked on page 249 of the testimony as to whether certain patents were in the suit of Fleischmann Company v. Liberty Yeast Company and he answered: "They are old familiar friends." I understand that plaintiff's counsel will agree that such patents were in that suit.

MR. WATSON: We will be glad to stipulate whatever the fact is.

MR. PHILBIN: It is also stipulated that the following patents relating to the manufacture of yeast were each granted on March 20, 1923, to the Fleischmann Company:

Hayduck	1,449,102
Hayduck	1,449,103
Hayduck	1,449,104
Hayduck	1,449,105
Hayduck	1,449,106
Hayduck	1,449,107

Hayduck	1,449;108
Hayduck	1,449,109
Hayduck	1,449,110
Hayduck	1,449,111
Hayduck	1,449,112
Hayduck	1,449,113
Hayduck	1,449,114
Nilsson and Harrison	1,449,127
Wohl	1,449,134
Wohl	1,449,135

Your Honor may recall that plaintiff offered a file, a wrapper, showing some patents were granted. The purpose of this is to show what patents were so granted.

It is also stipulated that the applications for the Hayduck patents in suit were assigned to the Fleischmann Company under date of——

Mr. Johnson: The assignment was recorded in the United States Patent Office on October 30, 1920. I think the assignments were received in this country very shortly before that date, with the patent documents. I am not certain just when the assignment was signed in Germany.

Mr. Philbin: That would appear from the assignments, would it not?

Mr. Johnson: Yes, I imagine it was some time about September, 1920.

Mr. Philbin: We will supply that information, your Honor, as to the date that the assignments bear.

Plaintiff was also to furnish defendant with certain data on the nitrogen-to-sugar ratios with respect to certain processes described in the Hayduck patents. Have you been able to supply that yet?

MR. JOHNSON: We have not had an opportunity to get that. We shall do so.

MR. PHILBIN: We ask leave to introduce that in evidence when supplied.

Defendant Rests.

REBUTTAL PROOFS.

JOHN W. LUCE, recalled in rebuttal on behalf of the plaintiff, testified as follows:

DIRECT EXAMINATION BY MR. JOHNSON:

Q. 155. There has been an issue raised by defendant as to whether or not in the Zulauf process in which yeast propagation is started in a dilute nutrient solution of about 1 degree Balling and the remainder is fed in in the form of a more concentrated nutrient solution in accordance with the growth requirements of the yeast, as to whether the alcohol, if any, which is formed by the yeast in this process is assimilated by the yeast during the period of propagation. I believe defendant's witness, Dr. Free, took the position that it was at best not assimilated until after all of the sugar had been fed in. Will you please tell us what you know about that, if anything?

A. It is my opinion that the alcohol is to a large extent consumed by the yeast. This is based on numerous tests which we have made of the alcoholic content present in the mash during fermentation. During the early stages of the fermentation, there is always a certain amount of alcohol present. During the early stages of the fermentation normally you are feeding in smaller amounts for sugar and there are smaller amounts of yeast in the fermentation. After the yeast reaches a certain stage of its growth our tests have

always shown that in spite of the fact that we have increased the amount of sugar fed, that the alcoholic content disappears and during the later stages of fermentation there is none or very, very little alcohol present. We conducted tests of this sort, at least since 1923 from time to time and we probably have done it hundreds of times.

We made the last test yesterday on a commercial mash, running in our plant at Peekskill. As to the alcohol content, it showed the same general relationship that existed in 1923, 1925, 1927 and 1932.

By THE COURT:

Q. 160. Do I understand that the alcohol content of the nutrient diminishes upon ceasing to inject sugar?

A. It diminishes even at the period that you are adding sugar in greatest amounts.

Q. 161. And then do I further understand that because the alcohol diminishes, it necessarily follows that it must have been absorbed by the yeast?

A. That is the natural explanation; and in further proof that that happens we have taken plain water and added that amount of alcohol to it, so that the percentage of alcohol in the plain water was the same as in the mash, and we have aerated this batch of plain water at the same rate of aeration as in the commercial mash, in order to find out whether there would be any evaporation of the alcohol from the air; and unless you go above the amounts of alcohol which are normally present in this type of mash, we don't find much loss of alcohol, if any.

Q. 162. In other words, aeration on a water-alcohol test does not cause the evaporation or disappearance by other means of the alcohol?

A. When it is in such small amounts. When it is in slightly higher amounts it will evaporate.

Q. 163. Well, does that conform to the examples given by Dr. Free—when he testified to the effect that he made just such a test, as I remember it? I don't remember that he gave us the conclusion, or result rather, of the test. He said that he made such a test by the use of alcohol in solution, but I don't think he gave us anything as to the result of it, did he? He said generally that that test led to a certain conclusion but not exactly the same as this witness is giving it to us.

MR. JOHNSON: As I recall, your Honor, he made the statement in direct examination that he had made such test and that he had found that alcohol was blown out in the blank test, but he did not put on the record the concentrations of the alcohol in the liquid which he was aerating.

Is that correct?

I stand subject to correction if the record shows differently, but I think that is right.

MR. PHILBIN: Dr. Free's conclusion was, your Honor, that yeast would not eat alcohol if there was available sugar which the yeast could use.

THE COURT: Yes.

MR. PHILBIN: He also stated that——

THE COURT: Now, this witness, as I understand it, takes the position that by reason of the fact that the alcohol disappears, there is but one assumption—that yeast consumes it.

MR. PHILBIN: I think he also said to your Honor, that some of the alcohol will be blown off by the air.

THE COURT: Yes.

MR. PHILBIN: Some of it.

THE COURT: Some of it.

MR. PHILBIN: But which is the more important—he may think that more of the alcohol is eaten by the yeast than is blown off, or he may think that very little alcohol is blown off.

THE WITNESS: Pardon me, may I make a statement?

MR. PHILBIN: Sure.

THE WITNESS: If the alcoholic content is at the levels which it normally is in these fermentations, I don't think much of it is blown off, based on our experiments with water. If it is at a little higher level, it certainly will be blown off.

By MR. JOHNSON:

Q. 164. Now, in the cross-examination of the defendant's witness, Dr. Rautenstrauch, he was asked concerning the tendency of the degree of acidity in a soured mash, soured by lactic acid, during the propagating period, and he stated that during the period of propagation the tendency is to increase the acidity. As I understood your testimony in prima facie, you were familiar with yeast-manufacturing processes in which cereal materials were mashed to form a nutrient solution, they were placed in a fermenter with seed yeast, and the mass was aerated, and during the mashing operations the materials had been soured with lactic acid bacteria, and the lactic acid bacteria subsequently killed by heating the mash, prior to introduction into the fermenter. Can you tell me whether or not in such a propagation the acidity of the liquid tends to increase or decrease? Of course, you understand, Mr. Luce, I am asking about those early processes as to which you have testified and not the processes which contain inorganic ammonium salts.

A. In that type of mash, the only time that I ever recall the acidity increasing was when it increased

due to infection. Normally speaking, the acidity in that type of mash always decreased. This decrease took place most rapidly after the sugars had been completely fermented out, and at that time it was our general belief that the lactic acid was a food for the yeast. At that time we always added sulfuric acid.

Q. 167. Counsel for defendant has introduced as Defendant's Exhibit D-8 (1) and other numerals some patents which were originally in this suit, with a statement that he intends to rely on them to show that the patents which remain in issue did not have the benefit of all the commercial success that plaintiff's counsel otherwise might ascribe to them. In defendant's case the witness, Dr. Rautenstrauch, referred to the Nilsson and Harrison process. Can you tell me whether or not that is the same as the A. M. process to which you referred in your testimony?

A. Yes. I believe it started in 1919 and was used for the next two or three years.

Q. 169. And the Wohl Patent 1,449,134 deals with a method of pre-treatment of molasses by acidifying it and treating it with a phosfate. Has the company used such a treatment?

A. Yes.

Q. 170. The Ransohoff Patent 1,688,831 deals with a process of pre-treatment of molasses in which the molasses is rendered alkaline and a substance is added to form the phosfate precipitate. Has the company used such a process?

A. Yes.

The company has used other processes for clarifying molasses. One of the primary purposes of such methods of treating molasses is to precipitate out pectins, gum substances and by filtering to give you a sterile solution for use in fermentation.

Q. 173. Will you tell me whether or not it is analogous to the pre-treatment and filtration of the grain,

aside from the saccharifying steps of course, used in your early practice?

A. No, they don't perform—they are both pretreatments, but in the one case, grain, you would have to go through that entire process in order to get a liquid medium.

Q. 174. Yes, I understand. But they both give a clear filtrate, do they not?

A. Oh, yes, they both give a clear filtrate.

Q. 175. The only other patent, I believe, in that list is the Wohl Patent 1,475,215, which covers a process of manufacturing yeast in which a cereal wort is prepared so that there is substituted from 10 to 50 per cent. of the organic nitrogen by inorganic ammonium salts. Has the company used such a process?

A. Yes.

Q. 176. To what extent has it used such a process with respect to the Zulauf patents in suit and the molasses, inorganic ammonium salt and neutralization processes?

A. Not at all, I would say.

Q. 179. Has the company to your knowledge used commercially a process of manufacturing yeast in which a sugar material, for example molasses, and inorganic ammonium salts have been used as the neutralizing agent, and in which in a straight-set mash the initial dilution of the solution was 2 degrees Balling or less?

A. Not commercially.

MR. PHILBIN: I am willing to accept Mr. Johnson's statement as to what the Fleischmann Company or the Standard Brands Company has used with respect to the patents which issued on that date of March 20, 1923. There is a long list of patents there, your Honor.

MR. JOHNSON: Thank you, Mr. Philbin, I shall state on the record that the Fleischmann Company,

or Standard Brands Incorporated, have not used commercially in the manufacture of yeast the processes of Hayduck Patents 1,449,104, '107, '108, '110, '112, '113, or the Reissue Patent 15,716, which is a reissue of the Series 1449, numbered '111. I shall also state on the record that the remaining Hayduck Patent No. 1,449,114 does not relate either to yeast as a product or to a process of manufacturing yeast, but relates to a foam-destroying device, a device which is to be used to take the foam off the tank of the fermenter, and impinge it against the wall, so that the foam breaks up and thereby the fermenter will not froth over.

Is that statement satisfactory to you?

MR. PHILBIN: It is entirely satisfactory, if it is correct, which I assume it is.

MR. JOHNSON: I think it is immaterial, therefore, as to whether I state on the record whether the foam-destroying device has been used commercially. I think it has been tried out. I might ask the witness as to that, however.

Q. 180. How do you commercially control the foam in the manufacture of yeast?

A. By the addition of fat.

Q. 181. Can you tell me whether or not you have tried any mechanical devices for doing that?

A. We have tried probably five hundred or a thousand different mechanical devices.

MR. JOHNSON: That is all.

CROSS-EXAMINATION BY MR. PHILBIN:

THE WITNESS: I said I made some experiments and tests with respect to the consumption of alcohol by yeast. I kept records of those tests. I have them here. That has several other things on besides that. I show you a sheet entitled "Date received September 15, 1925,

Laboratory No. 2672——" 25 C. B. 6 mash No. 1503, fermenter No. 16, Plant No. 1, signed Charles E. Roake, September 26, 1925. Charles E. Roake is a chemist, head of our laboratory at the Peekskill plant, where the tests were conducted. I was in charge of the plant at the time. I did not make the alcohol test myself, personally. I supervised the operation of that mash. I was present during the running of the results that are shown in this sheet. I see the names of some other gentlemen on this sheet, as follows: Above test by Mr. Tonkin, tested by Mr. Strang. They were men who individually made the laboratory determinations. This isdated in 1925. More than ten years ago.

This is not the latest evidence I have of any tests made by me with respect to consumption of alcohol by yeast. We made some tests yesterday.

I haven't the typewritten copy of the results of those tests there, or signed by the men who made the tests, and I was not present myself at the time that the tests were run. We have to take our laboratory results from that.

I have no records which were made where I myself was present at the tests since 1925, except this sheet of September 15, 1925. It does not show what materials were used in this process. In this experiment refiners' cane molasses, beet molasses and the inorganic ammonium salts, ammonium phosfate and ammonium sulfate, were used but no grain.

XQ. 204. What were the relative proportions of the molasses or sugar and salts, that is, were they approximately the same as used in the Fleischmann commercial process as of that time?

A. That was the commercial process.

Mr. Johnson: I believe, Mr. Philbin, the witness described that process on the record as C. B. process on prima facie.

XQ. 205. This sheet says that the percentage of the alcohol "in beer" varied from zero at the start and then was 2 per cent. at the first hour and 2 per cent. the second hour and 2 per cent. the third hour, then zero from that time on until the end of the process, which was eight hours.

A. May I correct that statement?

XQ. 206. Yes, sir.

A. .2 of a per cent. proof, which is equivalent to .1 per cent. absolute alcohol. 1/10 of 1 per cent. absolute alcohol.

XQ. 208. What is meant by "beer" in this connection?

A. That is another word for wort or nutrient medium.

XQ. 209. At the end of the first hour how did you determine that there was 2/10 of a per cent. on the basis of proof spirit in the alcohol?

A. Sample was taken from the fermenter at the end of each hour, taken to the laboratory and an alcoholic determination made.

XQ. 210. How did you determine that amount of alcohol in the sample that you took?

A. Well, a standard test is to take 1000 cc. of mash, distill it, collect the distillate in 500 cc. and then in a case of this sort where the amount is very small you determine the percentage of alcohol present by the use of a pycnometer. This operation was employed during this process.

In view of the low alcoholic content of the mash I doubt very much whether very much alcohol was removed by the air blowing through the beer or wort. The odor of alcohol was not apparent during this process. As to how I determined whether or not any alcohol was being blown off by the air during this process and how much it was, I can only answer that by repeating the same answer I made a little while ago.

This fermenter in which this work was performed was about 16,000 gallons and exactly 20 feet deep by 12 feet in diameter.

XQ. 217. Are you prepared to state that not as much as 1 per cent. of alcohol was blown out from this very large tank containing this large mass of material during this process?

MR. JOHNSON: Pardon me, do you mean 1 per cent. of the alcohol present?

MR. PHILBIN: No, I mean the 1 per cent. as shown here.

MR. JOHNSON: I believe he just told you that was 2/10 of a percent. or 1/10 of a per cent.; there may be a misunderstanding between you and the witness.

XQ. 218. Are you prepared to state that not as much alcohol was blown off during the process as the difference here shown between the stage when there is no alcohol shown, zero, and 2/10 of a per cent.?

A. Purely as a matter of my own opinion I don't think so.

I made no tests with respect to the alcoholic content of the air which came from the fermenter, so that this is purely my own opinion.

XQ. 223. And the only record or evidence you have of any test which you conducted is this one of September 15, 1925?

A. I have many other records which show the same thing.

XQ. 224. But you haven't brought them here?

A. I have a whole book of them here, they are all alike.

XQ. 225. May I see those other ones?

MR. JOHNSON: You understand, of course, that the witness was not present at the time some of these other records were done.

XQ. 226. I asked you—I meant to ask you, Mr. Luce, for any records of any work at which you were present with respect to this question of yeast-consuming alcohol.

MR. JOHNSON: I believe the witness has already told you that he had none.

XQ. 227. You have no others?

A. Since 1925, I made the statement. At this particular time I have eight or nine records at which I was present.

XQ. 229. About how much air did you blow through this mash in the eight or nine hours?

A. 3000 cubic feet per minute.

THE WITNESS: I really don't recall the purpose for making these tests in September, 1925, except that we are always making tests of all kinds in connection with our manufacture of yeast, and if you will note there are a great many other columns on there with information of various other kind on the mash. For instance, the Balling before and after filtration, and the amount of yeast present, and so on and so forth.

XQ. 231. Now, looking at one of the sheets you handed me, dated September 17, 1925, laboratory No. 2673, there is a column entitled "Alcohol in Beer with Percentages of Alcohol," and there is shown there that there is no alcohol present at all during that operation.

A. That is very possible.

XQ. 232. What do you conclude happened to the alcohol, if any was formed, in that process?

A. It was consumed as fast as it was—in fact, it probably was never formed, the yeast was active enough to consume the sugar right away. There is nothing on this sheet to show that. Merely my opinion that, there being no alcohol found, it must have

been eaten by the yeast instead of being blown off, if there was any substantial amount formed. My opinion, based on quite a little experience in the yeast business.

XQ. 235. Looking at another sheet, Laboratory No. 672, there at the beginning no alcohol was found; is that correct?

A. That is correct.

XQ. 236. Then at the end of the first hour there was found 2/10——

THE COURT: Just a moment, please. Can you give me any idea what the chemical analysis of the wort would be?

MR. JOHNSON: You mean this particular analysis, your Honor?

THE COURT: Any one of these you are now talking of. I will tell you why I ask that question. The assumption is on the one side that yeast consumes alcohol. The assumption is on the other side it does not, or at least they say there is no proof that yeast consumes alcohol. Therefore, I would like to know what the chemical analysis of the wort is, to the end that we may consider whether or not the alcohol, if not taken up by the yeast, and if not aerated out, might be changed in form by some of the other chemical ingredients of the wort.

MR. JOHNSON: I think perhaps this witness can answer that, but to give you a complete chemical analysis of the wort would be very difficult. I think he can satisfy your Honor's question.

THE COURT: I see what I am running into, though. I am running into just what I ran into in a case I had some time ago. In order to give an analysis you would probably have to subject the

wort to heat, and then the question would be whether you had manufactured the result or whether it was present in the solution.

MR. JOHNSON: I don't believe that is the case here.

THE WITNESS: Our test, of course, shows the amount of alcohol present there at any particular time.

THE COURT: And what else does it show besides alcohol?

THE WITNESS: Well, this particular test was only an alcohol test, that we are talking about right now.

THE COURT: Well, you see, you are asking me, as a trier of fact, to form a conclusion. One side says the yeast eats the alcohol up, and the other side says there is no proof of that fact, because in all of our investigations, analyses and so forth, we are unable to prove that yeast consumes alcohol. Now, I find that we have what is called wort, and what is called nutrient, and there is still another name for it, beer. Now, we have just dealt, then, with one of the factors or elements, rather, that you find. You have got yeast to deal with, you have got alcohol to deal with; there is nothing to show me what the chemical composition of the entire wort is, however, to the end that I may consider whether the alcohol had gone out through or been changed in form, through some one of the other chemical substances in the wort.

THE WITNESS: Well, we do have, of course, and have made countless——

THE COURT: Have you, either of you, made any such investigations?

MR. PHILBIN: Yes, your Honor.

THE COURT: Well, perhaps I am taking up unnecessary time. Proceed in your own way. I just wanted you to know that I have that in my mind.

MR. PHILBIN: Surely, your Honor.

By MR. PHILBIN:

XQ. 237. Is there sugar, fermentable sugar, which would be available to the yeast as food in that wort or beer which was tested?

A. Yes, it was there but we did not test for the presence of it in that particular test. It was there in large quantities, so that during this process the yeast could have eaten it if it had wished to do so. It was fed in in constantly increasing amounts. Yeast prefers, as a food, sugar to alcohol.

THE COURT: As I remember it, the testimony of one of the witnesses is that yeast will consume alcohol when it is not in the presence of sugar. So your contention, Mr. Philbin, is limited to that.

MR. PHILBIN: Yes, surely. No question about it. Yeast can get so hungry, just like any other plant——

THE COURT: That it will consume alcohol?

MR. PHILBIN: Exactly, your Honor, exactly.

THE COURT: Then it is an alcohol eater, all right, under certain conditions, isn't it?

MR. PHILBIN: Yes, your Honor. And I think that all the witnesses have so testified. Of course, that is what we naturally would expect from our knowledge of plants and animals, that when they are extremely hungry, they will eat almost anything, and alcohol has some carbohydrates in it, just like sugar; but the testimony is that, given the two sources, of carbohydrates and materials,

the yeast prefers to eat the sugar rather than the alcohol which it has excreted and formed.

THE WITNESS: May I explain my statement to you?

XQ. 243. Surely.

A. At this particular time, in the fermentation, there is a large amount of yeast present, and the amount of sugar which is fed to that yeast is not sufficient to satisfy it. For that reason, it will consume the sugar and whatever alcohol is present, because it does it even though you constantly increase the rate at which you feed your sugar; you nevertheless find that the amount of alcohol present goes down to zero, and stays there.

XQ. 244. Is it fair to state that the substance of your testimony is that you have performed tests and that you have had experience in the yeast industry, and you have found that when the yeast does not have enough sugar it will consume alcohol as a food?

A. Yes.

XQ. 245. How closely did this scale that you employed to measure the amount of alcohol in the samples that you took off register, that is, within what limits—how closely could you determine the alcohol?

A. Why, those tests were made on a pycnometer and not with an ordinary hydrometer. Of course, when you are dealing with such very small amounts of alcohol and you make a reading by a hydrometer the difference will be between .2 and .4 or even more possibly. In the case of a pycnometer you are actually taking the actual specific gravity of it and are working within very close limits.

I couldn't say what the limit of experimental error is. I believe with a pycnometer you can certainly get as close as 2/10 of a per cent. on the total amount of alcohol present. All I can say is that we were excep-

tionally careful in making these tests, simply because we knew that the amount was very low and we were anxious to know actually what it was. For that reason we took exceptional pains to get these tests accurate.

XQ. 249. Yes, but the way you did it was such, was it not, that you might have had an experimental error in observation of the order of 2/10?

A. I don't think so in the case of using a pycnometer; it certainly would be so in case we used a hydrometer.

In this column on laboratory sheet No. 2672 there are the figures 0.2 per cent. That .2 per cent. is on the basis of proof spirits present on the basis of the entire wort, about 12,000 gallons, to be exact.

XQ. 254. Now I am asking you, using the instrument that you spoke of and within the natural and unavoidable errors in making observations, are you prepared to say that these errors might not have been naturally of the order of 2/10 of a per cent.?

A. You must realize, of course, that when you make a test like this that you concentrate the alcohol which you actually have and take the portion of your mash and distill that off and concentrate that into a smaller portion, so that when you measure it you don't measure .2 of 1 per cent. but depending on the way you conduct your experiment; you might be measuring 1 per cent. in the actual test, and then you translate that figure back to your original dilution, so that your chances of error in doing that are much less than they would be if you simply took the original concentration.

Now looking again at this sheet No. 2627, the alcohol findings are all zero. In 2637 all zero; 2674 all zero except one reading of .2. No. 2651 all zero. No. 2673 all zero. No. 2671 all zero except two, each of which is precisely and exactly .2 per cent. within the limits of normal laboratory error I would say. The figures are precisely .2. No. 2672 all zero except

the figures of precisely .2 which occur in three places. No. 2595 in which they are all zero. And No. 2612 in which they are zero and two and five and four and four and two-tenths of a per cent.

XQ. 265. So that there is no reading here of anything below .2 per cent. is that correct?

A. Pardon me, anything below?

XQ. 266. Except zero?

MR. JOHNSON: Are you speaking of that one sheet or all of them?

MR. PHILBIN: All of them.

A. Correct.

XQ. 267. Is it a fair assumption that your instrument could not measure anything lower than .2 per cent.?

A. Well, I can explain that. Probably when we multiplied that from the original amount the multiplication wouldn't bring it back to that point, or rather when we divided.

XQ. 268. In your commercial operations do you keep zero amount of alcohol during the entire process?

A. It varies.

XQ. 269. Do you ever get zero alcohol, that is, no alcohol which you can determine during your commercial operation?

A. At the end of fermentation?

XQ. 270. At any time during the fermentation.

A. Normally speaking, I would say there is always some slight amount present during the first few hours of fermentation. That depends entirely on how you regulate your sugar feed, how you aerate, how much yeast you put in and in general how you run the fermentation.

XQ. 271. Have you ever made any tests to determine how much alcohol is blown off or evaporated from solutions such as these worts?

A. We have never made any tests to test how much alcohol, if any, was present in the gases coming off from the top of the fermenter, but we have made many tests trying to find out what happened and whether it was consumed, and those are what we based our opinion on.

XQ. 272. Is it a fact that alcohol will evaporate?

A. Absolutely.

XQ. 273. Is it also a fact that during these processes you have described there was some alcohol evaporated or blown off?

A. Why, when the alcoholic content is as low as it was on most of those tests I am inclined to doubt whether there was any alcohol blown off.

XQ. 274. But you never made any comparative tests to determine whether or not any alcohol was being blown off or whether or not the alcohol was being eaten by the yeast?

A. As I said before, I never made a gas analysis of the gas coming off.

XQ. 275. Did you ever run any test in which there was no yeast present so that there was nothing there to eat the yeast, and with a known amount of alcohol, and with air going through it, to see how much alcohol the air would blow off?

A. Yes, we have made those tests. I myself have not made any of those tests. There was no lactic acid in these tests.

MR. PHILBIN: I ask that the sheets referred to by the witness be marked as Defendant's Exhibit D-9 (a), (b) and so forth.

(Received in evidence and marked Exhibit D-9 (a) to (h) inclusive.)

By MR. PHILBIN:

XQ. 278. You spoke of acidity decreasing during the propagation, referring, as I understood it, to the

acidity of the wort. What kind of a mash did you refer to? That is, what was the materials used in the mash?

A. Cereals. Corn, malt, sprouts.

No other material was used as yeast nutrients in that particular mash. It was a mash in which all the nutrients were put in at the beginning. Sulfuric acid was normally added during the later stages of the propagation. During the first part of the propagation you would sometimes have a temporary, what you might call false acidity, due to CO_2 gas, but your acidity would decrease normally. The period of propagation was approximately eighteen to twenty-four hours—fourteen to twenty-four hours. I have no flow sheets or any records with me showing what the acidity was from the beginning to the end.

Plaintiff has never used in substantial commercial production a process in which there was employed for the yeast nutrients sugar, as distinguished from the sugar that is in molasses and grains.

XQ. 287. Has it ever used a process in which inorganic ammonium salts were used and some neutralizing agent, except in connection with a so-called Zulauf or regulated feeding process? And when I say "used" I mean also in substantial commercial use.

A. That would be a description of what we call the A M process if I understand your question, and we have used that in 1919 to 1921, along in there. It has been abandoned since then.

XQ. 290. Has the plaintiff ever used in substantial commercial production a process in which the concentration in the fermenter during the propagation was between 3 degrees and 5 degrees Balling?

A. Yes.

XQ. 291. When?

A. Since 1919 or '20, I should say.

XQ. 292. And to date?

A. Yes.

XQ. 293. In which the Balling in the propagating tank, in the fermenter, was between 3 degrees to 5 degrees Balling?

A. Oh, I misunderstood your question entirely.

XQ. 294. I am sorry.

A. No, the actual Balling readings start around 2.

XQ. 295. Has the Standard Brands Company, or Fleischmann, and I have been using the two interchangeably and I have been assuming that you so understood me, ever used a process in which the yeast was grown in a fermenter, and then a part of the yeast was withdrawn, and the part withdrawn was pressed and sold, while there continued to be grown in the fermenter the rest of the yeast?

A. Not commercially.

XQ. 296. Has the Fleischmann Company or Standard Brands ever used in substantial commercial production molasses and also magnesium sulfate?

A. No.

XQ. 297. Molasses and calcium carbonate?

A. Yes.

MR. PHILBIN: That is all.

HENRY J. KALTENBACH, called and sworn on behalf of the plaintiff in rebuttal, testified as follows:

DIRECT EXAMINATION BY MR. JOHNSON:

THE WITNESS: I reside at 150 Alta Avenue, Yonkers, New York. I am a retired vice-president of the Fleischmann Company. I have been with the Fleischmann Company about fifty-five years, from 1875. I retired from my position as vice-president between 1929 and 1930.

In connection with my work with the Fleischmann Company the yeast was the larger producing material or product.

Originally, in the early days the yield from a bushel of grain was about 3 2/3 gallons of alcohol and about four pounds of yeast, and gradually the processes improved the production of yeast by increasing the quantity. At that time the yeast was sold at thirty-five cents a pound and the alcohol per proof gallon about all the way from eight cents running up to a higher figure, depending upon the market. Before I left the Fleischmann Company the commercial yields obtained by that company on yeast based on the molasses and chemicals used was pretty nearly 80 per cent. of yeast.

Q. 11. And can you give me comparative figures as to the value of yeast produced from a gallon of molasses with an 80 per cent. yield, as compared to the value of the alcohol which you produced in a straight fermentation for alcohol from that molasses?

A. The yeast was decidedly better value.

Q. 12. Well, can you give us any general figures, assume yeast say at fifteen cents a pound and alcohol at whatever it was, 1929?

A. Alcohol about twelve cents a proof gallon.

Q. 13. And how many gallons of alcohol could you obtain from a gallon of molasses, straight fermentation?

A. Ordinarily 2½ gallons of molasses to make one wine gallon of alcohol.

Q. 14. That is two proof gallons——

A. You get one gallon of 80 proof spirits from a gallon of molasses.

Q. 15. And the value of that would be approximately what?

A. Perhaps about twelve cents.

Q. 16. And from a gallon of molasses at an 80 per cent. yield how much yeast would you get?

A. Well, a gallon of molasses weighs about 11.6 pounds; 80 per cent. of that would be about nine pounds plus.

Q. 17. And would fifteen cents a pound for yeast in 1929 be a very fair figure to take?

A. I think so, yes.

Q. 18. So that then we can simply multiply 9 by 15 and get $1.35 worth of yeast out of a gallon of molasses. Can you tell me whether or not the Fleischmann Company was always interested in increasing its production of yeast?

A. Yes.

Q. 19. And decreasing the alcohol yield?

A. Yes.

Q. 20. I believe the question is whether or not it was interested.

A. They were always anxious to increase their yeast yield.

CROSS-EXAMINATION BY MR. PHILBIN:

XQ. 21. The Fleischmann Company also was at times interested in obtaining a valuable yield of alcohol, wasn't it?

A. Not so much.

The Fleischmann Company made Gordon gin before Prohibition at Peekskill. They didn't sell it to the public, they sold it to the Gordon Gin people. But there were fairly large quantities made and sold by the Fleischmann Company to the Gordon Gin people. That particular contract was a profitable alcohol business of the Fleischmann Company.

XQ. 27. Now, when you sell yeast do you not also have to distribute the yeast to the various customers that are using the yeast?

A. Yes.

XQ. 28. And with respect to alcohol as a product, that also has to be distributed, that is, there are some distribution questions that come into it?

A. Well, in a measure it was distributed and sometimes delivered to car, not distributed to the customer. That was a wholesale business and the wholesaler either sent for it himself or we may have delivered it by truck or we may have sent it by car or boat or whatever.

XQ. 29. How about the yeast business in those days, was that more of a retail business than the alcohol business, as far as you were concerned?

A. The Fleischmann Company and its predecessors always dealt with the consumers.

XQ. 30. Can you give us some idea as to how many consumers of yeast there were which you sold to as compared to the consumers of alcohol? Were they about the same number?

A. No——

XQ. 31. Were there more yeast consumers than alcohol consumers?

A. Yes. That is, when you say consumers, as I said before, the alcohol was sold in wholesale. They were merely purchasers. I wouldn't like to accuse them of being consumers. I should say customers.

XQ. 33. There were a great many more yeast customers than there were alcohol customers. Can you give us some idea, only approximately? Ten times, one hundred times?

A. No.

XQ. 34. It might have been a thousand times?

A. I can't give you any idea. I could only guess. But I know there were a great many more.

XQ. 36. Can you tell us with respect to the distribution costs of alcohol as compared to the distribution costs of yeast? Because that, as we know, is one of the elements which determine whether a particular busi-

ness is profitable or not. Were the distribution costs in yeast greater than your costs in selling to your alcohol customers?

A. On what basis do you take it?

XQ. 37. Per dollar for yeast, was the distribution costs greater than that per dollar for alcohol you received?

A. I should say they were, yes, substantially.

XQ. 39. Considering these gallons of molasses that you used to make some alcohol, and to make some yeast out of, you got a certain amount of money for the yeast that you got from that molasses, and a certain amount of money from the alcohol, can you tell us which item was the most profitable to you; not which item you got the most in gross return, but which you made the most money out of?

A. The yeast business. It was the business of the firm. They strove to develop that. All their energies were directed to selling yeast and producing it.

At times we lost money on the alcohol we sold. I don't recollect that that was ever true of the yeast business.

The Fleischmann Company did use a process for making yeast in which molasses was used. I can't give you the figures on whether any substantial amount of alcohol was produced in that process.

XQ. 46. Mr. Luce, who I understand is with the Standard Brands Company, and was testifying on the same side as you are testifying, said that at one time, from 1917 until 1919, the Fleischmann Company used molasses, and that the average yeast yield in that process was 33 per cent., and that the alcohol obtained was two gallons?

Mr. Johnson: May I have the page of that record?

Mr. Philbin: I find that on page 102 of the testimony.

MR. JOHNSON: I don't think you intend to, but please don't mislead the witness if you can avoid it, because Mr. Luce was talking about a cereal and molasses mash, and I don't believe you mentioned a cereal in that question.

MR. PHILBIN: No, I did not mention cereal, but I merely asked if they had used any molasses.

XQ. 46. (Continuing.) But in that question will you also include the fact that there were other materials employed besides the molasses; that is, from 1917 to 1919 your company, as I understand it, used molasses and other materials, and obtained a yeast yield of about 33 per cent., and an alcohol yield of about two gallons. Do you recall that process?

A. An alcohol yield of two gallons for what quantity of material?

XQ. 47. Per 100 pounds of material.

A. I wouldn't like to state as to that because I never did any of the manufacturing.

I remember that we sold alcohol from 1917 to 1919. I remember that we sold yeast during that same period. At times we lost money on the alcohol business. I do not remember about those particular years.

MR. PHILBIN: That is all.

RE-DIRECT EXAMINATION BY MR. JOHNSON:

RDQ. 52. Mr. Kaltenbach, you were asked about the Gordon Gin alcohol business of the company. Can you tell us whether the alcohol used in making Gordon Gin was manufactured by the company as a by-product of its yeast manufacture at that time or was a special mash used for making that alcohol?

A. A special grain mash was used, no yeast was made from it.

MR. JOHNSON: That is all, thank you.

MR. PHILBIN: That is all.

JOHN W. LUCE, resumed the stand.

RE-DIRECT EXAMINATION BY MR. JOHNSON:

MR. JOHNSON: I should like, if possible, to clear up your Honor's mind on this question of whether there is anything in the materials being tested for alcohol which would take up the alcohol. In that connection I note——

THE COURT: No, not materials that are being used but the other elements in the wort——

MR. JOHNSON: Yes, sir.

THE COURT: —other than yeast or sugar.

MR. JOHNSON: In that connection I should like to call your Honor's attention to the fact that in this sheet from Dr. Free's notebook giving the results of his alcohol analyses on experiments 14 and 15, which I believe is copied into the record, the same figure on the pycnometer reading appears, that is, .104 grams per 100 cc., which is .1 per cent.

THE WITNESS: A pycnometer determination of the alcohol content of alcoholic liquids in general is not an ordinary routine method of analysis.

I don't think there is anything in the wort or beer that was tested for alcohol in these tests to which I have referred which would take up the alcohol if it were present.

RDQ. 300. Several chemists in the laboratories of Standard Brands at Peekskill were mentioned by Mr. Philbin in your cross-examination. Were they competent chemists and thoroughly capable, in your opinion, of carrying out this pycnometer test?

A. Very competent chemists.

RDQ. 301. I don't believe the record is quite clear on the real meaning of the word "beer" in the yeast

industry, as distinguished from propagating liquid, for example. Will you please explain that?

A. It is synonymous with the nutrient wort. It is usually spoken of, however, as the liquid that is left when the yeast is taken out of the fermenter. In this particular case the man wrote the word "beer" down; that was his way of designating the sample of the mash.

I spoke in my cross-examination about the fact that there was alcohol present during the first few hours of the propagation. The majority of those sheets introduced by Mr. Philbin as Defendant's Exhibit D-9 (a), (b) etc., show as to the alcohol content of the propagating liquid after the fourth or fifth hour that there is no alcohol present according to those tests.

RDQ. 303. I believe you said as to the first one of those sheets that was given to Mr. Philbin that it was from a commercial run at the Peekskill factory. Is or is not that true of the other sheets which were introduced as a part of that exhibit?

A. I believe that one of those sheets was what we know as a seed yeast fermentation. I would have to check that by looking at the sheets.

I find one and will read the number of it into the record. Laboratory 3612, I believe it is. That is Defendant's Exhibit 9-d. As to the others, they were all regular commercial fermentations.

Mr. Philbin asked me on cross-examination whether I had added acid to propagating liquids in cereal worts, that is, lactic acid soured worts of which I spoke. I never knew of any alkali being added; in fact, it was heresy in the yeast business at that time to even think of adding alkali to that type of mash.

MR. JOHNSON: That is all.

MR. PHILBIN: That is all.

ARTHUR B. LAMB, recalled in rebuttal, testified in behalf of the plaintiff as follows:

DIRECT EXAMINATION BY MR. WATSON:

Q. 312. Please refer, Dr. Lamb, to Plaintiff's Exhibit 2, the second patent in suit, '105. As you testified on direct examination, this patent has a sentence reading:

"The quantity of the diluted wort which is originally available for the yeast is so chosen, for example, that the mean content of the entire wort employed would be 3° to 5° Balling."

The defendant's expert, Dr. Rautenstrauch, testified or expressed his opinion of the meaning of this sentence, among other places in the record beginning 198. In general he expressed the opinion, as I understood, that this instruction in the Hayduck patent meant the wort in the propagating vat should have an average Balling between 3 and 5 degrees during the propagating period. Do you agree with that conclusion?

A. No, I do not. I can see no support for it in this sentence that you refer to, nor elsewhere in the patent.

Q. 312a. Just examine Dr. Rautenstrauch's testimony for a moment, please, at pages 198, 199 and 200.

THE COURT: Is it proper to ask the Doctor now how he interprets it?

MR. WATSON: Oh, yes. We asked him on direct. Now I am asking him——

THE COURT: Well, I want to get that again now, if you will refresh my recollection.

MR. WATSON: I am asking him to express his opinion on the logic by which Dr. Rautenstrauch reached a contrary conclusion.

THE COURT: Yes, but I would like now to have my memory refreshed, if necessary, by turning

back to his testimony, for the purpose of showing me how he interprets that clause. Now, as I look at it, it would seem to me that, given a quantity of diluted wort,——

MR. WATSON: The Court will note the statement that the quantity is the thing chosen to arrive at this mean content.

THE COURT: That given quantity——

MR. WATSON: Well, it might otherwise be any quantity but the patentee says that he selects such a quantity of the diluted wort as will provide——

THE COURT: What does it mean by originally available as distinguished from simply saying available?

MR. WATSON: Your Honor will recall that he makes up his molasses nutrient solution to a Balling, for example, of 12 degrees. That is spoken of at the beginning of the paragraph. And then he takes a part of that to put in the propagating vat.

THE COURT: In which to sow the seed yeast?

MR. WATSON: In which to sow the seed yeast. And that part which he takes he dilutes down, as he says, for example, to about 1 degree Balling, and that is the material which is originally in the fermenter, and the amount of it——

THE COURT: I suppose he means then, as you say, "originally available" to be that quantity of composition of wort of between 3 and 5 into which he is about to sow seed yeast?

MR. WATSON: No, it isn't 3 to 5 there; he has already specified what that quantity is and there is no disagreement on that. That quantity has a Balling of 1 degree. You see, he has diluted that partial fraction down to 1 degree.

THE COURT: Let me get this correct, start right at the beginning of this process and let me have it, if you don't mind, and if counsel wants to interrupt all right; but I would like to know just how this process works out.

MR. PHILBIN: May I remind your Honor of what Dr. Rautenstrauch said?

THE COURT: Yes.

MR. PHILBIN: He testified that Hayduck says you make a wort of 12 degrees; you have that——

THE COURT: Well, now I am going to put that down as the first step.

MR. PHILBIN: Yes, the first thing you do.

THE COURT: The first wort 12 degrees Balling.

MR. WATSON: That is the relatively concentrated wort.

THE COURT: He makes that first. What does he do next?

MR. PHILBIN: Now he does not state, your Honor, how large that wort is, how many gallons, but he merely states it is to be whatever is desired, 12 degrees.

THE COURT: 12 degrees Balling.

MR. PHILBIN: Next he places a part of that wort, which is highly diluted to 1 degree wort.

THE COURT: Wait a minute, part of 12 degrees Balling wort what?

MR. PHILBIN: He dilutes to 1 degree.

THE COURT: Diluted to 1 degree.

MR. PHILBIN: And puts that——

THE COURT: Now, wait a minute, that is another step. Third puts that where?

MR. PHILBIN: In the fermenting vat with the seed yeast.

MR. WATSON: We agree so far.

MR. PHILBIN: Third, from the reserve——

THE COURT: Third?

MR. PHILBIN: From the reserve tank——

THE COURT: Now, that's another tank somewhere.

MR. PHILBIN: That is from the 12 degrees, the reserve solution.

MR. WATSON: That is the balance.

THE COURT: Now you are talking about the No. 1.

MR. PHILBIN: Yes, your Honor. Take from that——

THE COURT: Now, take from the one which is 12 degrees Balling——

MR. PHILBIN: And put that into the fermenting tank.

MR. WATSON: At a rate——

THE COURT: That's where you come to disagreement, I suppose.

MR. PHILBIN: No, no disagreement on this, your Honor.

THE COURT: Put that in the fermenting tank?

MR. PHILBIN: You put that in the tank.

THE COURT: Now, up to that point you agree?

MR. PHILBIN: Yes, your Honor.

MR. WATSON: It eventually get in the tank but it gets in over a period, it flows in, it isn't all dumped in.

THE COURT: What do you say is the fourth step?

MR. PHILBIN: It is poured in continuously or as requirements of the yeast——

THE COURT: As required.

MR. WATSON: That's right, in accordance with the yeast requirements.

THE COURT: I will put it down this way: as required by the yeast. Now, I have third step: take from No. 1, which is the 12-degree Balling, put same in fermenter tank as required by yeast.

MR. PHILBIN: Yes, your Honor.

THE COURT: What is the next step after that?

MR. PHILBIN: The solution, of course, should be fed naturally and obviously at a proper rate so that——

THE COURT: As required by the yeast.

MR. WATSON: That is the process.

MR. PHILBIN: Now, next, your Honor, we come to this particular sentence.

THE COURT: That we are now dealing with.

MR. WATSON: That is right.

MR. PHILBIN: That we are now dealing with which speaks of "the mean content of the entire wort employed would be 3° to 5° Balling." Dr. Rautenstrauch thought that those words meant as they are written, the 3 degrees to 5 degrees Balling was the Balling in the fermenter when the yeast was eating the food in the wort; that is, you start with 1 degree of a certain quantity and you pour in from the 12 degrees until you have an average of about 3 to 5 degrees in the solution where the yeast is eating the food.

MR. WATSON: Now, I want to ask this witness why that interpetation by Dr. Rautenstrauch can not possibly be the correct one.

THE WITNESS: I think that question can be answered easily, without any elaborate scientific explanation, because the very sentence itself states that the quantity of the diluted wort which is originally available for the yeast, that is the portion in the fermenter, the diluted wort in the fermenter, of 1 degree Balling, "is so chosen, for example, that the mean content"[1] and so forth, shall be secured. Now, on Dr. Rautenstrauch's interpretation, the amount of that initial dilution is of no significance. It could be large or small, dilute or concentrated; by adding the concentrated wort from the reserve tank, on his interpretation, the 3 to 5-degree Balling could be maintained irrespective of the amount of the dilute solution originally present.

THE COURT: Am I correct, then, in saying as to the language of the specification just quoted that your position is that the quantity of the diluted wort which is originally available is that wort which we have referred to as a 12-degree Balling wort?

THE WITNESS: No, that is the——

THE COURT: Well, it is the wort originally available, isn't it?

THE WITNESS: No, not originally available to the yeast, because the yeast is not in a concentrated solution, it is in a dilute solution.

THE COURT: Let me follow that through a little further. Assume, just now, for the purpose of getting this problem straight in my mind, that I conclude that the quantity of the diluted wort which is originally available, because the word "origi-

nally" is used, would refer necessarily to the 12-degree Balling wort.

MR. WATSON: But it can't, your Honor, because it is diluted.

THE COURT: That is not my question. You haven't got my question yet.

MR. WATSON: Excuse me.

THE COURT: Where did I leave off?

THE REPORTER: "Assume, just now, for the purpose of getting this problem straight in my mind, that I conclude that the quantity of the diluted wort which is originally available, because the word 'originally' is used, would refer necessarily to the 12-degree Balling wort."

THE COURT: Then I take it, that that 12-degree Balling wort is to be fed into the tank where the yeast is growing in such proportion that the mean content of the entire wort will range between 3 and 5 degrees Balling.

Now, what is wrong with that?

MR. WATSON: Your Honor has put your finger on Dr. Rautenstrauch's testimony. There are two points in connection with it which I wish to point out.

MR. PHILBIN: I don't think he answered your Honor's question, whether there was anything wrong with that. We see nothing wrong. Do you?

MR. WATSON: I say he has expressed the position of defendant's witness. It is our position that the sentence cannot refer to the 12-degree Balling, even though it says "originally available," because the sentence says, "The quantity of the diluted wort"——

THE COURT: Yes, I know.

MR. WATSON: And the 12-degree Balling isn't the diluted wort. The 1-degree Balling is the diluted wort. Therefore——

THE COURT: That would be the second step that I have got here.

MR. WATSON: That has got to be the second.

THE COURT: The second is "part of the 12-degree Balling wort diluted to 1 per cent.," and you say it refers to that one.

MR. WATSON: Yes, if the Court please.

THE COURT: The other side says it refers to the 12-degree Balling wort. Now, let me see.

MR. WATSON: May I ask Mr. Philbin whether he caught your Honor's question?

MR. PHILBIN: Yes, your Honor.

MR. WATSON: That it is defendant's position that the diluted wort in line 91 refers to the 12-degree Balling wort?

MR. PHILBIN: The quantity of the diluted wort which is originally available for the yeast, which means, as we take it, which the yeast is using or availing itself of from time to time——

MR. WATSON: Well, it is not the 12 degree.

MR. PHILBIN: ——is taken from the 12-degree Balling, comes from that originally, and as the yeast is eating it, it is somewhere between those limits in the fermenting tank.

MR. WATSON: Well, defendant's counsel has not answered the Court's question, does the diluted wort refer to the 12-degree Balling.

MR. PHILBIN: The diluted wort refers first to the 12-degree Balling; then that is diluted, first to 1-degree Balling; the 1-degree Balling——

THE COURT: I think we can get this straightened out by you who are more familiar with what happens. You certainly wouldn't be diluting anything if you put 12-degree Balling in, would you?

MR. PHILBIN: No, your Honor.

MR. WATSON: No, sir.

THE COURT: All right. Now, how could you expect, then, to reduce the content from 3 to 5, if you were putting 12 in, 12-degree Balling?

MR. PHILBIN: You couldn't, your Honor. You would start with 1, and you would add 12 ——

THE COURT: Therefore, it must be that they are referring to the 1-degree Balling, which is the second step in what you have given me, because the feeding in is done for the purpose of reducing the Balling, is it not, not to let it increase above 5?

MR. PHILBIN: No, it is to increase the Balling, your Honor.

MR. WATSON: It is to give more food to the yeast, just put it that way.

THE COURT: Well, then, I guess the first answer you gave me wasn't correct. You could, then, feed 12-degree Balling in, and cause a reduction in the Balling of the entire mass.

MR. PHILBIN: No, your Honor, it increases the Balling, because you have 1 degree in the tank——

THE COURT: Yes.

MR. PHILBIN: —which is a very weak solution, comparatively. You have got a much thicker solution in your reserve tank—namely, 12 degrees. You start with 1 degree, and you pour in from the 12 degree, thereby increasing the dilute concentra-

tion—the thickness of what is in the fermenting tank.

THE COURT: What effect does the yeast have on the Balling? Does it diminish the Balling? I assume that it does.

MR. WATSON: It does, your Honor.

THE COURT: Therefore, what you have got to do is to put something in that wort to keep its Balling measurement up.

MR. WATSON: Yes, your Honor.

MR. PHILBIN: Yes, your Honor.

THE COURT: Therefore, you must put 12 degree in.

MR. WATSON: Oh, you always feed from the reserve, sure.

MR. PHILBIN: And the yeast, as it grows, and as there are more and more yeast cells in this tank, need more and more sugar and other food.

MR. WATSON: I wonder, if the Court please, if we could visualize it a little easier by saying that we have got a pitcher of thick molasses here and we are going to take some of it and mix it with water and make a glass of thin molasses. This thin molasses is our diluted wort. We have still got a thick pitcher of what is left which we are going to pour in. The sentence says that we so choose the amount of this thick portion that we thin down in the glass to make our thin glassful, we so choose this thin glassful that, etc. Now, therefore, we say the language calling for the quantity of the diluted wort must refer to the quantity which goes over to make our thin glass. It cannot refer to the thick molasses saved over in the pitcher because that

has not yet been diluted, the remainder of it. We are just talking about this thin glassful.

THE COURT: What would prompt you to put that 1 per cent. thin in when you are endeavoring to bring it up to between 3 and 5 degrees, when the original mass is set at 1 degree—what would prompt you to put that additional 1 per cent. in? Let Dr. Lamb explain it, will you?

MR. WATSON: Yes, sir, with pleasure.

A. I think I can explain—of course, we have all taken a crack at it, so to speak. Speaking very broadly and simply, the patentee wants to grow yeast under optimum conditions and he thinks that he must do that at about 1 degree Balling dilute solution and he must feed the nutriment in so that the yeast won't have too much food. That has all been spoken of elsewhere, so just keeping in mind what you are trying to do is to keep the environment of the yeast pretty nearly the same, keep it about 1 degree Balling, for instance food supply, keep it dilute, there is therefore prepared a dilute solution which is very nice for the yeast to grow in, to start with, and the remainder of the solution stays out to one side in a reserve vat or barrel and can be utilized to feed the yeast as the yeast consumes this small amount of food in the dilute solution, which it would rapidly do if more food were not furnished. The food is furnished it at a rate so that this constant supply of food is maintained all the time. So what the yeast grower is trying to do is to maintain this dilute favorable condition for the continued growth of the yeast.

By THE COURT:

Q. 313. You say he is trying to maintain it at 1 degree?

A. Pretty near 1 degree or thereabouts, the dilute condition. Now that is his object.

Q. 314. How could that be so when the language we have just been discussing clearly says that it is so chosen, for example, that the mean content of the entire wort employed——

A. Yes, that is it.

Q. 315. —would be 3 to 5 Balling?

A. That's exactly it, the entire wort.

Q. 316. Now, the entire wort is poured into the fermenter between 3 and 5, isn't it?

A. No, the entire wort, that distinguishes from the dilute solution in the fermenter to include the concentrated solution as well, so that the mean content of the entire concentrated and dilute——

Q. 317. That is being used and not being used?

A. That would ultimately all be used in the growth of the yeast because ultimately——

Q. 318. What would be the object in that?

A. Well, the object is this, as I——

Q. 319. Why did he say anything about 3 to 5 when it is being maintained at 1?

A. That is just the point.

THE COURT: Well, I am glad I see that.

A. (Continuing.) In order to maintain this low value 1 degree, as you have seen, he feeds in the concentrated solution and the reason for using this particular scheme or one reason is so as not to have to use too big vessels, he can use a concentrated solution then in a small container, small reserve vat. It does not take much space. Now, suppose someone wanted to carry out this invention, he might say, "Well, I will only take a little of this very dilute solution, just a small amount in the bottom of the fermenter, and I will seed it with yeast and I will be able to run in a whole lot of my concentrated wort, a little at a time,

always keeping 1 degree. I will be able to use a great deal of this concentrated wort in this process because I will be able to fill up practically my whole tank ultimately with this concentrated wort as the yeast eats up the sugar," etc. But if he should do that he would get so much yeast formed in that big vat and so many salts would remain from the molasses, etc., that unfavorable conditions would ensue for the growth of the yeast. The inventor had tried this process out and realized that and he there said that you must not take too little of the dilute solution to start with because if you take too little of the dilute solution you will get overcrowding in your vat; you must take, he said, such a quantity of the dilute solution that your mean volume of the entire wort is between 3 and 5, which reckons out in the fermenter two-thirds full, say, of the dilute solution, and then taking the mean Balling of the dilute solution and the concentrated comes out between 3 and 5.

By Mr. Watson:

Q. 320. What is the average Balling in that sense, Dr. Lamb? We have the diluted portion and the more concentrated portion. Does the average Balling mean what the Balling would be if you just dumped the two together and had one container?

A. No, if the volumes of the dilute solution and of the concentrated were the same and one was 1 and the other was 12, when you mix them together they would be just about 6½ because then the volumes would be the same; if the volume of the dilute were only one-tenth that of the concentrated, or we will say one-ninth for convenience, then when you mix them together your average Balling would be pretty near 11 because you would have so little volume of the dilute solution. So the 3 to 5 is the figure for the average Balling of the entire wort originally available for the yeast.

Q. 321. Without yeast being present?

A. Surely, these are all understood without the presence of yeast. So that the language is really crystal clear once you see what it is all about, couldn't be stated more elegantly and exactly than it is stated, and so far as I know in the previous litigation this has come up and this idea had never occurred to anyone that it could have such a really absurd meaning, it was never mentioned.

MR. JOHNSON: Your Honor please, I believe I am the only one who hasn't tried to explain it. Is it clear to your Honor yet? If not, I think I can give you a concrete example on the record, without going off the record, that will certainly clear it up.

THE COURT: Proceed.

MR. JOHNSON: In Plaintiff's Exhibit 14, which is one of defendant's commercial operations—of course it is plaintiff's position that that is an infringement of this very patent.

MR. PHILBIN: May it please the Court, I don't want to object, but I don't see that what the defendant did has to do with what the words are, used in this patent.

MR. JOHNSON: I am using this merely as a concrete example of what we are talking about here. Now, Dr. Lamb described that process on the record in detail and among other things he told the total volume of the dilute nutrient solution chosen by defendant to put in its four fermenters that were used, and that total volume of dilute solution was 37,000 gallons. Now, the defendant had control of that operation, it could have used, as Dr. Lamb says, a smaller amount, it could have had 4000 gallons total in there if it

wanted to, of this dilute solution, but it chose to use 37,000 gallons. Now, it had in addition to that, in reserve, a wort around 12 degrees Balling, 12.9 in one case, something else in the other, and the amount of that reserved wort was such that—I might say that reserve wort first was fed into the fermenter in such a way that if your Honor will look at mash sheet M-177, the Balling in the fermenter, the density in the fermenter, started at 1 then .9, .85, .9, 1, 1.05, 1.20 and so forth, and it increased as the yeast in fermenter increased, but it was not 3 to 5 Balling; it finally got up with all the yeast yield in it to 2.3. Now, the amount of reserve wort fed into those four fermenters was such as Dr. Lamb calculated on the record multiplying their volumes by their densities, etc., and getting what we call the Balling units, that if at the start when they had 37,000 gallons of dilute wort in those fermenters they had done nothing but dump the whole mass of reserve wort in there at one time without any yeast being present or any action of the yeast, they would have had a mean Balling or an average Balling of those two solutions of 3.6. In other words, I may mention this mash at the present moment merely as a concrete illustration of the ability of the yeast manufacturer to so choose the amount of his dilute wort with respect to the amount of his concentrated wort that he has a mean Balling between 3 and 5.

THE COURT: All right. You start in your manufacturing process with a 1 per cent solution of nutrient wort or beer?

MR. JOHNSON: In the fermenter.

THE COURT: In the fermenter. The next thing you do is to sow the seed of yeast in that liquid. The yeast proceeds to consume the sugar which

will lower the Balling. To prevent a lowering of the Balling you have in reserve a tank containing 12 degrees Balling wort.

MR. JOHNSON: That's right.

THE COURT: Now your object is to feed that 12 degrees Balling wort into the natural process that is going on in the fermenter, but at such a rate that it will maintain the 3 to 5 degree Balling while the yeast is growing.

MR. JOHNSON: No, your Honor.

THE COURT: That is one side of it. Now let me see if I understand your side of it. That is the defense. The plaintiff says no, that is not correct, you start with a 1 degree Balling in the wort; you sow the seed in it of the yeast, and as the yeast commences to consume the sugar you do pour in a quantity which you have saved on the side for that purpose and that which you pour in is a 1 degree Balling reserve.

MR. JOHNSON: No, it is a 12 degree Balling poured in at a rate such that the yeast consumes it and maintains the 1 degree Balling approximately in the fermenter.

THE COURT: Oh, I see.

MR. JOHNSON: And that is shown on this mash sheet.

THE COURT: Now, I understand that. Now, then, I don't understand then why it was necessary for the inventor to say anything about 3 to 5 because it becomes absolute surplusage.

MR. JOHNSON: We all want to tell your Honor. As I say, they had four big fermenters here that were specified in their answers to interrogatories as being 15,000 gallons capacity. Now let's take

one of them and get into round figures, if we may; let's say that instead of 37,000 gallons in each fermenter—that would be 9500 gallons, I believe, in each fermenter—at the start of 1 degree Balling, they might have used, your Honor, they might have taken twenty-five gallons of that 12 degree Balling wort and diluted it so that they only had 275 gallons of 1 degree Balling wort in the fermenter, but they didn't do that, they took 9500 which is several times the volume of the reserve wort fed in there. So that the inventor tells you to do that, and he gives you the rule for selecting the amount by saying that you so choose from the 12 degree Balling the amount that you want to dilute to 1 degree Balling, that if you mix the two together, just put them in a stirring machine and mix them, you would have a Balling of 3 to 5. He gives that rule as an example.

THE COURT: So that the nutrient, then, that you feed in is to be between 3 and 5.

MR. JOHNSON: The nutrient you feed in, your Honor, is the 12 degree Balling wort, but the measure or rule that the inventor is talking about here has nothing whatever to do with the propagating process. It is a pure, physical selection of a certain amount, diluting that to 1 degree Balling, and so selected that if you took the other and averaged them, as Dr. Lamb has done (you would never mix them together——)

THE COURT: Well, I think, now, I have got it reasonably clear as to just what the process is, so I will now understand the Doctor's testimony a little better.

MR. WATSON: I only wanted to add one thing more, and maybe it will clear it up. There are two

things involved. One of them is the rate of feed. The other one is, before you ever start feeding at all, a division of materials.

MR. JOHNSON: That is a mathematical calculation.

MR. WATSON: A selection of relative amounts and relative Ballings. Now, this sentence refers to that selection of relative amounts and relative Ballings. There are some other sentences in the specification which refer to the rate of feed, about feeding it as the yeast requires it. But this sentence, it is our position, refers to the original division and selection; whereas, it is defendant's position that this sentence does not refer to the original division and selection, but to the rate of feed. We are agreed on that, aren't we, Mr. Philbin?

MR. PHILBIN: No, your Honor. I don't agree that that sentence relates to the rate of feed. I agree with Mr. Watson that that sentence has nothing to do with the rate of feed but, if anything, it has to do with the dilution and the quantity. I agree with that. It is our view that that means that when the yeast is eating the food, the wort in which the seed is contained that the yeast is eating, is to be somewhere between 3 and 5, given as illustrative examples. I do not wish your Honor to understand that defendant is insisting upon exact correspondence to these illustrative figures. The patent gave as an example 1 degree dilution, 12 degree dilution, 3 to 5 degree dilution. I understand those figures to be merely illustrative examples of the general process that Hayduck patent is describing.

THE COURT: Now, in outlining the process a moment ago, we had the first step, which was a

quantity of 12 degree Balling wort, and then the second step was the dilution of that to a 1 degree Balling.

MR. WATSON: A dilution of part of it.

THE COURT: Part of it, to 1 degree. Is that second step of 1 degree Balling then set aside for the purpose of starting the process of manufacture?

MR. WATSON: That is right; that is right.

THE COURT: Into that 1 degree, you place the seed.

MR. WATSON: That is right.

THE COURT: Now, that leaves you nothing left over but your 12 degree.

MR. WATSON: That is right.

THE COURT: And your 12 degree is your original mash from which you start?

MR. WATSON: That is right.

THE COURT: Your theory is you pour that in——

MR. WATSON: Our theory is, first, if I may interrupt, that this——

THE COURT: You both agree, then, that you pour the 12 degree Balling in?

MR. WATSON: Oh, yes.

MR. PHILBIN: Yes, your Honor.

MR. WATSON: Our position is on this sentence that it is the selection of how much of that thick stuff you take to dilute down into how much. So that there is an arithmetical relationship.

THE COURT: But always gaged by what the yeast will eat and consume?

MR. WATSON: What the yeast will eat depends on the rate of feed, not on the original selection of fractional division.

THE COURT: Well, perhaps I am taking a lot of your time.

MR. WATSON: No, it is very helpful.

THE COURT: We can clear that up afterwards. I just felt that I might understand the Doctor's testimony if I could clarify that point. So if you will proceed now, these points that I have raised we will discuss when the evidence is all in.

MR. WATSON: It is our position that this particular thing is merely an arithmetical calculation.

THE COURT: As an example.

MR. WATSON: As a rule, which this defendant has chosen to follow, and which is a very advantageous rule.

THE COURT: In other words, I assume from the sheets, then, of the defendant, that the defendant will take the position that inasmuch as the Balling never got up to 3, its process, therefore, differs from this, because this disclosure sets forth 3 to 5.

Am I right in assuming that that is one phase of this issue?

MR. PHILBIN: Yes, your Honor. Defendant's process differs in that specific respect as to the degrees of Balling. We do not consider that that necessarily would avoid infringement of the broad principle. That is, if the patent teaches——

THE COURT: That process.

MR. PHILBIN: —a regulated feeding——

THE COURT: Yes.

MR. PHILBIN: —and gives as an illustrative example certain particular things, and defendant

uses different degrees of Balling, that would not, in my opinion, avoid infringement because——

THE COURT: In other words, you have learned what you were doing from this patent.

MR. PHILBIN: Irrespective of those degrees of Balling—we do not use the specific degrees, we think, according to our understanding. But, as I say, I do not think that is a controlling consideration.

THE COURT: Proceed.

THE WITNESS: (Continuing.) As to that subject I did want to point out that—I mentioned two or three points as what I wished to speak of, and I have covered one; namely, that the interpretation of Dr. Rautenstrauch is not compatible with the clear statement in English of this sentence, it is incompatible with the sentence itself, as I have outlined at some length.

Now, there are two other points. In the first place, if the average Balling were 3 to 5, that would be on the face of it opposed to the general teaching of the patent. 3 to 5 is not a dilute solution, a particularly dilute or highly dilute solution or wort. Solutions of 5 degrees were not unusual in the date preceding this patent in the commercial manufacture of yeast. He has emphasized the importance of having the solution dilute, so as to promote yeast growth as contrasted with fermentation. He would defeat his purposes to run it at 3 to 5. He starts at 1 degree, because that is about the optimum concentration, and he wishes to maintain that throughout. So it would be absurd for him to cite right there in that paragraph a rule in contradiction of his main thesis. Secondly——

By THE COURT:

Q. 323. You say, then, that the 3 to 5 applies to the wort held in reserve?

A. It is an arithmetical relationship between the amount of the dilute solution that you take and the amount of your concentrated wort on the side. It just tells you what relation there is between those two amounts. If the patent didn't give that, it would be deficient, it would not be adequate in its teaching, because otherwise you are given no information as to how much dilute solution to take for a given amount of concentrated solution. This rule tells you.

Q. 324. But you do say, Doctor, do you not, that you feed in a 12 degree——

A. Yes, you feed in the concentrated solution into this 1 degree solution, that is the desirable concentration, and you keep it there; that is the point, you keep it there.

Q. 325. Why was it necessary, then, for the inventor to explain that on the side there was anything that had to be between 3 and 5?

A. Well, I wonder if there are two tumblers here.

Q. 326. We will get them and see if we can make the process clear.

(No answer.)

Q. 327. Now, so that I will understand it, Doctor, let me start you down to the point where we don't understand each other. We start out with the 12 degree Balling here, and the next step is 1 degree Balling. Now, that 1 degree Balling is our manufacturing factor?

A. That is right.

Q. 328. Now, we put the seed of the yeast in that, and as the yeast consumes the sugar, we pour a little more in?

A. That is it.

Q. 329. Always watching it to the end, you say, that it does not get above 1?

A. Not much.

Q. 330. The other side, to the point that it does not get above 5?

A. Right.

Q. 331. And should be mean, between 3 and 5. Now, here you have what?

A. Well, may I continue with your experiment?

Q. 332. Yes.

A. This was the original wort.

Q. 333. Yes.

A. Undiluted. This is the reserve wort. This is a portion of dilute wort of 1 degree Balling. I now proceed——

MR. JOHNSON: Pardon me, Dr. Lamb, so this will appear correctly on the record and be intelligible, will you please indicate the amount of the wort that is in the dilute portion there?

THE COURT: One per cent.

MR. JOHNSON: Well, in inches in the glass, or something, that is all I have in mind.

A. (Continuing.) The reserve wort has, let us say, 90 cubic centimeters by volume. The diluted wort, let us say, has 10, the original being 100 cubic centimeters, for instance I have, in other words, placed 10 per cent. —the volume of this solution in the fermenter is 10 per cent. of the total volume. I now proceed to add this concentrated wort to the dilute wort, slowly and continuously, as the yeast eats up the sugar, keeping this at 1 degree, and obviously I can pour in practically the whole of this solution into that vat and produce yeast corresponding to the total amount of that solution in that vat. Now, that was using only one-tenth of the volume in here, of the total volume, or one-ninth of the volume of this concentrated wort.

I wonder if I can have some more water, your Honor.

I think you will see that I only need to take a very little of the concentrated solution, in order to produce

the dilute solution, because I added mostly water there —only, say, about 1 per cent. of that concentrated solution was necessary——

Q. 334. To bring the other to 1?

A. To bring this to 1, at the start.

Now, let us repeat the experiment under different conditions. Let us pour in here quite a little more of this concentrated solution than I did before. Instead of 1 per cent., we may pour in 4 or 5 per cent., and I will dilute this down with water to 1 per cent. I now have a 1 per cent. solution in here; but I filled this up nearly three-quarters full.

Q. 335. Now, where does that patent say to put that water in there?

A. A portion of the solution, of the original solution, is diluted.

Q. 336. Will you turn to the patent?

MR. WATSON: Line 70.

THE COURT: Line 70?

A. Of course, that is self-evidently with water.

Q. 337. Highly diluted?

A. Highly diluted. The difference in this experiment from the other is that I, in the first experiment, just took a very little of this and diluted it up, so that this was only one-tenth full. In this experiment I have taken more and diluted it up until it is nearly three-quarters full.

Q. 338. Yes.

A. I will now proceed with my feed, as the yeast has been put in and it is growing. I now feed in the concentrated wort in order to furnish the sugar for the yeast growing, and I maintain it at 1 degree; but obviously I can only pour in about a third of my solution, or a quarter of it, because I have filled the tank up. Not so good. The yeast maker wouldn't like it. He says, "Well, I want a wort with just a little in my

fermenter." The patentee says, "You must not work with too little, you must have your proportions so that the average—you must use enough water, that is, to make up your dilute solution you must use enough of this dilute solution so that the average of the entire wort that you use is 3 to 5 and you will have no trouble."

Q. 339. If you put these together now you ought to have 3 to 5?

A. Three to five, if it is right.

MR. JOHNSON: Without any yeast present, your Honor.

MR. WATSON: That is just an arithmetical proportion.

THE WITNESS: It is just an arithmetical relationship, stated, unfortunately, too briefly—that is, you will have to think pretty carefully to see what it means, but it is perfectly clear and definite—in controlling the proportions that must obtain for satisfactory yeast manufacture, between the diluted wort on the one hand and the concentrated wort on the other—that is, on the basis of the entire wort employed.

Q. 340. Now, let's look at the word "employed" for a moment, in this example. All you employed is that which went into the manufacture. You haven't employed this reserve over here, it hasn't been engaged at all in employment, in the manufacture of yeast, what you have got left over. So if he says here that the mean content of the entire wort employed would be 3 to 5 degrees Balling, and you haven't employed this, how can you justify your measuring it at all? Because he limits you here to the wort employed.

A. Well, you would have to use——

Q. 341. Not the wort reserved?

A. You would have to use additional tanks then, in order to use this all up, and you would get——

Q. 342. Oh, I see.

A. It would all work out the same.

Q. 343. Oh, yes.

A. And you would be outside the rule if you tried to do it on any such——

Q. 344. But the theory is that that would be constantly employed?

A. Yes.

Q. 345. All the way through?

A. Yes.

Q. 346. Until it was all gone?

A. Yes.

THE COURT: Yes; I think I have a reasonable understanding of it now.

By THE COURT:

Q. 346a. Now, Doctor, returning to this example for a moment. In the first step of the process wherein you take from the 12 degree wort and start by diluting it to a 1 degree wort, you have as a reserve then 12 degrees in the reserve quantity, 1 degree in the operating wort?

A. Yes.

Q. 347. And if you put them together that gave you what approximately, just roughly, around 11?

A. Well, if you——

Q. 348. No, that would cut it in half, that would cut it down to about 6 or 7?

A. It would all depend on what amounts of that diluted wort you took. The simplest case is where you take equal quantities.

Q. 349. Yes, where you take equal quantities.

A. Suppose you took a certain amount of the concentrated wort and diluted that by water up to the same volume of concentrated wort so that you would

have two worts of equal volume, if you mix those together it would give you just about 6.

Q. 350. Now, how are you going to do it to make 3 to 5?

A. Well, it works out——

Q. 351. How could you ever get a set-up so you could make 3 to 5?

A. All right, I will tell you how it works out. I am a little short of room for water here but perhaps I can——

(Witness performs experiment with three glasses partly filled with water.)

THE COURT: You see my difficulty is I cannot see where they get that 3 to 5.

THE WITNESS: I think I can show you.

(A fourth empty glass is furnished to the witness.)

By THE COURT:

Q. 352. You are going to show me how as 1 is to 12 you are going to get 3 to 5.

A. Yes. There is the original concentrated wort 12 degrees Balling. I take a small part of this and add enough water to bring that to 1 degree and have this fermenter about two-thirds full. I can now, you see, pour in this into that without overflowing. This is 1 degree. The yeast grows. I feed in the reserve wort and I just get enough to feed it in over twelve hours, say, keep it at 1 degree and I don't overflow my fermenter, and these worts will be within the rule, this volume of concentrated wort 12 degrees Balling plus this relatively larger volume of dilute 1 degree poured together will come within 3 to 5.

Q. 353. That is because you have added water.

A. That is because I have added the right amount of water; you have to do this arithmetical calculation

in advance in order to do that, it isn't self-evident by any means.

By Mr. Watson:

The Witness: It is also because I have added the right fraction of my starting heavy concentrate. I have so chosen the formula of the diluted solution that the mean Balling of the entire wort, after you mix them all together, is 3 to 5. I have done nothing but what the plain English says that you should do and at the same time I have stuck to the teachings of the patent to maintain the concentration of the dilute solution about 1 degree throughout the fermentation and have fed this material in to meet the yeast requirements for growing.

Q. 355. There are other portions of the specification, are there not, Doctor Lamb, which give instructions as to the rate of feed as distinguished from instructions as to the division of materials for average concentration?

The Court: That is not the easiest way by which this thought could be expressed, by any means, is it, this 3 to 5 limitation? Why isn't it all settled by the 1 degree disclosure? I don't see why you have to have that 3 to 5 or are concerned with it at all.

Mr. Watson: This afternoon, I think, if the Court please, we can have some actual sugar solutions and a saccharimeter.

The Court: I hope I am not wasting your time on this.

Mr. Philbin: No, your Honor, we think it a very important part of plaintiff's case and also defendant's case to understand what is meant by this '105 patent.

MR. WATSON: I think this subject is in substantial dispute between the parties.

THE COURT: It seems so.

MR. WATSON: And therefore, if the Court please, I think it justifies all the time that is necessary to clear it. There are other points of less importance.

THE COURT: Is this one of the major issues involved?

MR. WATSON: I think it is and I want to see if I can visualize the situation from another point of view; if we can get something graphic it is sometimes easier.

THE COURT: Yes, if I can see it I will be able to remember it much longer than I would from the testimony, if I can have a demonstration of some kind such as we have just had here; it is very helpful. Of course, my mind isn't cleared up entirely yet, but I can see what the warring contentions are to at least a limited extent.

MR. WATSON: It is our position, of course, that this is a preliminary to the yeast manufacture.

THE COURT: You see, when you look at the problem presented here from the standpoint of the logic involved in it, the inventor says you start with 12 degrees Balling. Now, obviously, that would be absolute surplusage, because you might start with 5 and feed faster or rather feed in greater volume to the yeast, as it consumes, and I cannot think that it is reasonable that an inventor would start with 12 degrees Balling unless it was in some way connected. The only way I could see that that 12 degree starting point would be connected with anything would be upon

the theory that it is to be used in comparison with a 3 to 5 somewhere at the end; otherwise the 3 to 5 is surplusage. Either one or the other of those statements, disclosures as we call them, is meaningless standing alone. I see that dimly at the moment.

Mr. Watson: Your Honor, if I take a vessel of 12 degrees wort and I am going to take some part of that, put it over in another vessel and in the second vessel I am going to dilute it, but first I have got to decide how much of that I will take for diluting, obviously I can draw a line, I can take that much or that or that or that (indicating); I can draw a line anywhere along there. This rule tells me where I will draw that line, how much of that I will take to put over here and dilute.

The Court: How much does it tell you to take?

Mr. Watson: It tells me to take such an amount that when I put it over in the second vessel and dilute it up to 1 degree, my relations will be such—a mathematical calculation, just plain arithmetic—my relationship shall be such that if I then dump them together, which I am not going to do of course in yeast manufacture at the moment—but if I did I would wind up with a vessel, the Balling of which would fall between 3 and 5 degrees. Now, I cannot arrive at that Balling of 3 to 5 unless my division of the starting material is in the particular equations. So then when I have divided them up in that correct proportioning and corelationship, then I am ready to make yeast.

The Court: But when you get through with your entire process, all of your 12 degree Balling

is gone so that the only thing you have left is a mathematical calculation?

MR. WATSON: For this original division. Of course, if I took a very small amount of the thick syrup——

THE COURT: You see, Mr. Watson, if you stop this without using all of your 12 degree solution you never come to 3 to 5.

MR. WATSON: Oh, but if the Court please, this is merely a rule of materials. Now I am going to have, I will say, 10,000 gallons of thick material; the rest of my apparatus is adequate so that that is all going to be used up in one yeast run, manufacturing run. How much I take of the heavy reserve depends upon what my manufacturing facilities are, but whatever those facilities are I take a certain amount of the thick 12 degree material and this arithmetical rule tells me how I shall divide that heavy starting material as a preliminary to the conduct of my yeast manufacturing operations which I am going to carry out.

THE COURT: You cannot get any 3 to 5 out of it until you have finished your whole run, can you?

MR. WATSON: Oh, if the Court please, you never get 3 to 5 in your actual run because what you get in your actual run——

THE COURT: Well, in looking at these disclosures, the inventor says positively 3 to 5, doesn't he?

MR. WATSON: Well, what you get in your actual run is the Balling controlled by your rate of feed and the rate of yeast multiplication. Now, the inventor gives very specific instructions on the rate of feed. He says that your feed is, as your Honor noted, in accordance with the optimum yeast food

requirements. That is the rule for the rate of feed, and if you follow that rule your Balling, as in all of these operations, does not arrive at 3 to 5. If you fed so rapidly that your Balling went up to 3 to 5, it would mean that you were violating that rule of feed because the Balling could rise only because you were feeding faster than the yeast could assimilate it.

THE COURT: I wonder if it is possible—is this a translation from the German—it isn't, is it? No, we have to take it as it is.

MR. PHILBIN: We take it as it is.

THE COURT: You see it might be that in the translation something was confused but this is not a translation.

MR. PHILBIN: No, we have to take the disclosure as it is in the patent.

THE WITNESS: Your Honor, may I say just one word that I think may clear up your last query about 3 to 5? The sentence referred to makes it clear that that is a purely hypothetical experiment, "so chosen, for example, that the mean content of the entire wort employed would be," not is—it would be. It is a wholly conditional—it is an imaginary situation.

By THE COURT:

Q. 356. It is something that you can never get until the process is completed and then get only by a test of the wort remaining in the manufacturing yeast?

A. Oh, no.

Q. 357. Then it would be between 3 to 5?

A. No, Judge. You do this before any yeast manufacturing begins. You could perform a hypothetical experiment, mixing these two, dilute and concentrated

solutions, together, and if you obeyed the rule and took the right proportions of those substances, liquids, you will have a mean Balling of 3 to 5. The yeast-maker does not have to do that because he has a pen and pencil and he can do it in a moment with arithmetical calculation.

THE COURT: Gentlemen, at the opening here something was said about these patents being paper patents. What was meant by that?

MR. WATSON: That was a remark made by defendant's counsel.

THE COURT: By that I assume is meant that they are patents that were never strictly followed?

MR. WATSON: That is an odious term applied to patents which have had no commercial importance. That is defendant's position. Of course it is our position that these are patents which are of pioneer character and have revolutionized the manufacture of bakers' yeast all over the world.

By THE COURT:

Q. 358. Will you write, Doctor, this formula the way you say it is and do it in the set-up that I have here. You see, I am trying to get this to a conclusion and I haven't been able to do it. Now can you read my writing?

A. Yes, I think so.

Q. 359. First you have a 12 degree Balling, then your second step in the process of manufacture is the 12 degree Balling was diluted to 1.

A. Yes.

Q. 360. Then comes your third step, putting the second, which is the 1 degree, in the fermenting vat with seed yeast; three, take from 1 and put some in fermenting tank as required by yeast. Now, that does not help me a bit in the 3 to 5 problem, do you see?

Now, if you could just sit down and write that out just as you would write a recipe for your daughter, if you have one, to bake a pie, showing what the recipe is——

A. Would you like to have me do it right here or do it tomorrow?

Q. 361. I think perhaps we would save time if you would do that right here in these different steps I have given you. I don't think it would take you long because you have a clear idea, which if I can get it in my mind, would be very helpful.

Mr. Johnson: May I suggest, Dr. Lamb, that it might be helpful to put in some little sketches at the same time you are writing.

The Court: You see, when a baker uses your yeast, he has a recipe by which he manufactures bread. I want to get in this recipe this 3 to 5 somewhere. I haven't been able to read it in.

(At this point a short recess was taken.)

The Court: Was this point dealt with in any of these opinions?

Mr. Watson: Yes, sir.

The Court: Which one?

Mr. Johnson: 38 Fed. (2d)—well, the actual page is 331, on which Judge Soper quotes that rule, and I also might call——

The Court: Just give me the language there. Where does it start?

Mr. Johnson: He is describing the Hayduck process. "The specification expressly declares"——

The Court: What line is that?

Mr. Watson: That is the last paragraph in the first column.

MR. JOHNSON: On page 331.

THE COURT: All right, I will read it.

MR. JOHNSON: I might also call your Honor's attention to page 339 at the top of the first column and the bottom of the second column of the preceding page, where the Ballings in the fermenter, in the defendant's operations in that case, are set forth.

THE WITNESS: I have completed it.

THE COURT: Show it to counsel, please, and if you want to confer on it you may do so. I would like to have that marked.

MR. WATSON: Yes, sir.

THE WITNESS: I will say in explanation of what I have handed Mr. Watson, that it is an illustrative procedure, taking a particular volume of concentrated wort.

THE COURT: What particular claim reads on this example?

MR. WATSON: Of '105, claims 4, 8, 9 and 10 were held valid by Judge Soper. There was no holding of invalidity with respect to any of the claims.

MR. PHILBIN: I think your Honor's question was what claim reads upon the particular example that we are discussing.

TH COURT: Yes, that is the question.

MR. JOHNSON: Does your Honor mean whether any of the claims specifically include this limitation, 3 to 5?

THE COURT: Yes, which claims do read on that example?

MR. PHILBIN: Which comes the nearest to that example?

MR. JOHNSON: None of them contain that limitation. It is not an example. It is a rule.

MR. PHILBIN: I must confess, then, I don't see what we are wasting all this time for.

Do not any of the claims of that patent have anything to do with this question of dilution and Balling?

MR. WATSON: Oh, yes, Mr. Philbin.

MR. PHILBIN: Which claim comes the nearest?

MR. WATSON: All of the claims which I have referred to.

MR. PHILBIN: Claim 4?

MR. WATSON: That rule, if the Court please, is of importance in yeast manufacturing to accomplish the subject-matter set forth in these claims, and is availed of by this defendant, following the disclosure of this patent, and infringing the subject-matter of those claims.

THE COURT: You said that was Claim 4——?

MR. WATSON: And Claims 8, 9 and 10.

MR. PHILBIN: May we take Claim 4 as typical?

MR. WATSON: All of the claims are in issue here but I just speak of those as the ones which were held valid by Judge Soper.

MR. PHILBIN: As I understand it, then, we may consider Claim 4 as typical of the process in which is embodied this dilution feature.

THE COURT: No, he hasn't limited himself to that extent.

MR. PHILBIN: No, your Honor, but he said that Claim 4 is one of the claims.

THE COURT: Yes.

MR. PHILBIN: And he has not said there was any better claim.

May I say to your Honor that just reading it I find nothing in it with respect to adding the dilute wort to concentrated and having a mean concentration. That doesn't, it seems to me, appear in the words of the claim.

THE COURT: It is disclosed in the eighth claim.

MR. PHILBIN: No, your Honor.

THE COURT: What does it mean when it says in the eighth claim "adding during the period of propagation, the wort of higher concentration at a rate such that the yeast may propagate and substantially all of the alcohol which may be formed is assimilated by the yeast"?

MR. PHILBIN: Merely that you should add the nutrient as the yeast may desire. It is not a statement that what you add of 12 degree Balling or any other degree Balling when taken and added to the 1 degree Balling has an average——

THE COURT: I don't understand that the inventor is limited by the example that he may give in his specifications, is he?

MR. PHILBIN: No, your Honor, I entirely agree he is not limited to the specific examples.

THE COURT: Of course, we have this difficulty. Then we also have a difficulty as to whether or not yeast consumes alcohol in the presence of sugar.

MR. WATSON: That point we will take up next. That we will pass over, I think, more quickly because that, I think, we both agree has a relatively trifling significance.

MR. PHILBIN: No.

THE COURT: Have you seen this answer?

MR. PHILBIN: Not yet, your Honor.

THE COURT: Mr. Philbin, if you will examine it.

A. I have patterned this after your outline.

THE COURT: I couldn't wind it up to get the 3 and 5, I got the other figures.

THE WITNESS: I have put in where the 3 to 5 comes in, although I haven't simplified the rule, I simply said the rule.

By THE COURT:

Q. 362. Dr. Lamb, I asked you if you would write a formula or recipe covering the idea expressed from line 90 line 95 of the specification in Patent 1,449,105, Hayduck, and in doing so you have used the technical form of set-up which you, as an expert, would ordinarily give for the purpose of assisting the Court. I will ask you to read your answer, if you will, to the end that there may be a copy thereof in the record, and then we will mark this answer of yours as an exhibit.

A. Hayduck—'105.

I. A wort of 12 degree Balling is prepared (say 2500 gallons).

II. A part (650 gallons) of this wort is diluted in the fermenter with water to 1 degree Balling; that is, water is added until the volume is twelve times as great, that is, 7800 gallons. These selected volumes obey the rule as to mean Balling. Thus—and there follows the calculation of the mean Balling, namely, 7800 gallons at 1 degree Balling gives 7800 Balling units; 1850 gallons, the residue of concentrated wort at 12 degrees Balling gives 22,200 Balling units. These

Balling units added together give 30,000 Balling units, which divided by the total volume of the entire . . . 9650 gallons, gives a mean Balling of 3.1, which is within the rule as to the mean Balling.

III. Seed yeast is added to the diluted wort (II). Aeration is started and the feed of concentrated wort (12 degrees Balling, 1850 gallons left) into the dilute solution is started and maintained. Final volume will be 9650 gallons.

IV. The yeast is harvested.

I ought to say that these calculations were made somewhat hurriedly and I think are correct.

By Mr. Watson:

Q. 363. There has been testimony offered by defendant on the question of whether yeast will assimilate alcohol during the propagating period. The testimony of defendant's witnesses, we think, varied considerably on that subject, but I will state, as far as I can recall it, the final opinion expressed by the defendant's witnesses, which was to the effect that yeast would not consume alcohol unless there was no sugar present, or unless the yeast was starving. Will you turn, please, to Hayduck Patent '105 in suit and express your opinion as to what the disclosure of the patent is on that question of alcohol assimilability? I call your attention to the first paragraph at the top of the second column.

Mr. Philbin: May it please the Court, I do not recall any difference of opinion among defendant's witnesses as to what yeast did in the presence of sugar and I therefore object to Mr. Watson's statement to that effect.

The Court: Well, that is a matter of argument.

MR. WATSON: I didn't want it in the question, I am sorry it was in the question, but I——

MR. PHILBIN: I also disagree with Mr. Watson as to the importance of this particular issue of yeast consuming alcohol in the presence of sugar. We do regard it as important because this Hayduck patent does emphasize it, it is contained in some of the claims, and, as Dr. Free stated, it is the only statement that he knows of in the literature to the effect that yeast will assimilate alcohol, under such circumstances.

THE COURT: You may answer the question, Doctor.

A. I am sorry, I will have to ask for the actual part of the question to be read to me.

Q. 364. I am just asking you to express your opinion on the disclosure of the '105 patent, in the paragraph referred to on that subject.

THE COURT: It begins at the top of the second column, page 1 of the patent.

A. Yes. In this paragraph the inventor first points out the goal that he holds before him, that is of obtaining a high yeast yield, and to indicate how he hopes to obtain this high yeast yield he describes his proposed procedure; that is, to add the wort continuously, and at a rate such that no large excess of alcohol will be formed, and the yeast will assimilate most of the alcohol which is so formed. There is no conflict that I can see here with the idea that the yeast ultimately will consume that alcohol, if formed, in small amounts. Indeed, my opinion is that the arguments on this question as to whether or not the yeast will eat alcohol at all, have been refined to a point where it is of little moment really one way or the other. The experts that I know of that have testified agree that yeast will eat alcohol under certain conditions.

THE COURT: But not in the presence of sugar?

THE WITNESS: Certainly not in the presence of sugar under ordinary conditions; but it is a good deal a matter of common sense, that if you have a lot of yeast cells, millions of them, billions of them there, eager to secure food, and you offer them two kinds of food, they are not going to sit around and wait, consult their greatest preferences. If they are actively growing, they will, in general, select the food that is absorbed more rapidly and easily, that is the sugar. But there will be some alcohol. It is only a matter of common sense that some alcohol will be utilized under these conditions, if they can use it at all. It is, therefore, my opinion that small amounts of alcohol are undoubtedly assimilated by rapidly growing yeast in the presence of sugar.

THE COURT: Mr. Watson, of what interest is it to the Court whether it does or does not consume alcohol; if it be shown or disclosed, we will say, in the patent and then is demonstrated by the process that alcohol diminishes, that is all that is necessary. I am not supposed to go into the question of whether or not the yeast consumes the alcohol or not, so long as the alcohol diminishes. Then that is disclosed. And we aren't called upon to go any further, are we?

MR. WATSON: I think that in general is correct. We have evidence in the case that defendant conducts its manufacturing processes so that no alcohol is formed or produced as a final product. That testimony has been given.

THE COURT: Because these things in the last analysis are infinite. It is beyond the power of demonstration to prove them.

THE WITNESS: Yes, sir.

THE COURT: Take two men of equal learning, one says the yeast consumes the alcohol and the other says it does not. Obviously, there is nothing to help the trier of facts to determine whether it does or not, assuming the witnesses are equally qualified to speak on the subject, because there is no demonstration possible of the truth or falsity. The only thing the Court can consider is that a certain fact is presented, to wit, in this case, a diminution of alcohol content in water.

MR. PHILBIN: The witnesses agreed, I think, as has been observed, that yeast would rather eat sugar than alcohol. If there is no sugar available the yeast will eat the alcohol. I don't know that there is any dispute as to that.

THE COURT: Then apparently there is really nothing disputed on the point.

MR. PHILBIN: But the importance of this is whether or not in defendant's process the plaintiff has succeeded in proving—because the burden is upon the plaintiff of proving—that the yeast has been eating alcohol or did eat alcohol during defendant's process. Our position is that there is no evidence that such alcohol as may have been formed during defendant's process was eaten by the yeast. It is important also, because the only test in the Hayduck patent of how quickly you should feed this nutrient solution into the vat is that it should be at a rate so that no alcohol is formed, or if any alcohol is formed it is eaten up by the yeast, and that, we submit, is a purely theoretical statement of a result and does not give to the practical yeast manufacturer any way of determining whether or not this particular rate is used;

so that I again say the burden is upon the plaintiff to show that in the defendant's process the yeast does eat alcohol and that, we think, the plaintiff has not done.

MR. WATSON: We will meet that in argument, I think.

THE COURT: It is helpful to me from time to time to have counsel take a position because I see then more clearly what the issues are.

MR. WATSON: On the mash sheets in evidence which show defendant's operations the Court will remember that they fed in the reserve material for less than the total period of the yeast manufacturing operation and the yield of yeast is increasing during the whole time, and there is testimony in the record that if there was any alcohol formed it would be and was assimilated at one time or another in the manufacturing operation as conducted by the defendant.

(Outline by Dr. Lamb received in evidence and marked Exhibit P-19.)

(Recess.)

FRANK A. FEILD, called and sworn for the plaintiff, testified as follows:

DIRECT EXAMINATION BY MR. JOHNSON:

My name is Frank A. Feild, superintendent of Federal Yeast Corporation, Baltimore, Maryland.

I have been employed by the Federal Yeast Corporation in its yeast manufacture since January 1, 1924.

Q. 3. If I as your superior asked you as a yeast manufacturer to prepare a 12 degree Balling wort and to take a portion of it and dilute it to 1 degree Balling, and add the remainder, after this dilute portion had

been seeded with stock yeast, to satisfy the growth requirements of the yeast, and I told you to choose such a quantity of the diluted wort originally available for the yeast that the mean Balling of the entire wort employed would be from 3 to 5 degrees Balling, just what would you do?

A. I would prepare a nutrient solution of say 2500 gallons at 12 degrees Balling. That would be the first step; and that would be all of the raw materials that would be used in a solution form. I then would take a portion of this concentrated material, such as, we will say, about 650 gallons, and I would dilute that, if 1 degree Balling is required—I would reduce that from 12 per cent. to 1 per cent. by adding a sufficient amount of water to give me the desired 1 degree Balling.

I would, then, figure out the amount of material of the concentrated form that I would have to use and the amount of water which I would have to use to dilute that with in order that the final average mean Balling would represent a figure of about 3 to 5 per cent. Balling. In other words, I would be interested principally in the amount of water which would be required to dilute the 12 per cent. material. That would be a fixed amount of water and it would give a definite fixed amount of final volume.

THE COURT: In other words, you have listened to the testimony of Dr. Lamb and perhaps have examined this Exhibit P-19, which is written, and you agree with it?

THE WITNESS: I agree with it.

MR. JOHNSON: I believe the witness has not seen that exhibit, your Honor. He was present this morning and he did select the 2500 figure that Dr. Lamb started with.

Q. 4. What I am getting at principally is this, Mr. Feild: Would you determine the amount of 12

degrees Balling wort which you were going to separate and dilute by arithmetical calculation?

A. Yes, it is arrived at arithmetically.

Q. 5. That is, you would not, in order to determine that you were going to have a mean Balling of 3 to 5 degrees, dump all the materials in the fermenter and mix them up?

A. No. This is merely a preliminary calculation in order to determine after having a fixed amount of material available, this is merely a calculation to determine how much water would be required and what the total volume at the end would be, because the gravity or the percentage Balling has been determined beforehand; that has been given to me to adjust the other ingredients accordingly.

MR. JOHNSON: That is all.

THE COURT: Do you operate under such formula as this?

MR. JOHNSON: If your Honor please, I would rather not go into the manufacturing processes of the Federal Yeast Corporation which is not a party to this suit.

THE COURT: Just a minute, objection sustained. But I want to ask another question.

By THE COURT:

Q. 6. Do you operate as a licensee under any patents?

A. We do.

Q. 7. Are they any of the patents that we are concerned with here which you have heard referred to in the course of the trial?

A. Not as a licensee under any of these patents.

Q. 8. But you have permission to operate under some patents?

A. We have our own patents.

MR. JOHNSON: Is that clear to your Honor? The witness——

MR. WATSON: I can answer the question. This witness is with the Federal Company against whom suit was brought as reported in the Federal Reporters, and that suit was decided in favor of plaintiffs and there are decrees of record which prevent the company from using these processes and there is no license between the plaintiff and the Federal Yeast Company. So we assume the Federal Company is obeying the Court's decrees.

CROSS-EXAMINATION BY MR. PHILBIN:

XQ. 9. You said, Mr. Feild, that you would prepare a solution which would, as Mr. Johnson said, satisfy the growth requirements of the yeast.

A. No, I did not say that.

MR. JOHNSON: I said that he was to feed it to the yeast in accordance with the growth requirements.

XQ. 10. How would you determine what were those growth requirements, that is, at what rate would you feed it?

A. Well, yeast will grow in any concentration; it will grow in a 12 per cent. solution, it won't die—you mean optimum growth?

XQ. 11. Yes, from a practical manufacturing proposition, you testified that you would pick out a certain amount of material and you would use a Balling of about 12 degrees and that you would feed it so as to satisfy the growth requirements of the yeast, and now I am asking you what you mean by those terms.

MR. JOHNSON: If your Honor please, I object to the question on the ground that it is outside of the direct examination.

THE COURT: I will allow it.

MR. JOHNSON: Because I asked the witness merely about the proportioning of the concentrated wort and the dilute wort.

THE COURT: I will allow it.

XQ. 12. Do you remember testifying on direct, Mr. Feild, about feeding the yeast in accordance with the growth requirements?

A: I don't remember testifying to feeding the yeast to any growth requirements in my testimony.

XQ. 13. Well, now, how would you determine——

MR. JOHNSON: That is a fact, your Honor, and that is why I object to the question.

THE COURT: Yes, but I will allow it. I desire to be informed on the subject.

XQ. 14. How would you determine it, as a practical matter, Mr. Feild? Here you say you start with 2500 gallons, containing this yeast nutrient solution, and you say you feed it to the yeast, naturally and obviously at such a rate that the greatest amount of yeast will be formed from a practical point of view; what I am asking you is how you determine, in your judgment, as a practical plant superintendent or production man, what that rate should be, whether it should be very quick or very slow or whether it should change during the period or how?

A. You don't determine it at any one time but by a series of experiences. There are two ways of determining how much yeast you have. You can determine that at the final period of propagation by harvesting the whole crop and weighing it and knowing exactly how much yeast you have produced from a certain amount of raw materials. You can, however, get the yield at any intermediate point in the process by removing a sample, filtering it and weighing it from

a given sample, and calculating it back to the total volume. A yeast maker always determines, if it is an experimental run, what his intermediate yields are. He can actually plot a curve, showing yeast growth, and knowing normal yeast growths or yeast growths that are in his experience, he can tell whether or not he is getting a better yeast growth than he is accustomed to, or an inferior yeast growth, in terms of yield.

You determine that, as a practical matter, by experience and by testing your yeast from time to time, during the process, and seeing how much yeast you have got at different steps and how much you have in the end.

XQ. 18. And, I suppose, that with different kinds of materials, molasses and grains and salts, there would be differences in the rate of growth of the yeast and in the rate of feed?

MR. WATSON: If the Court please, we must object to that on the ground it is outside the proper cross-examination. However, if Mr. Philbin wishes to make the witness his own, we will let him continue to ask any questions he wishes.

THE COURT: Yes, you will make him your own witness if you go on.

MR. PHILBIN: I don't think there is any question about it. I am perfectly willing to have Mr. Feild tell us whether that isn't a fact, that the rate of growth of the yeast depends upon what kind of materials you use, and the relative proportions of those materials.

A. It depends upon many variables. The more important ones are the amount of raw materials, the concentration of them, the kinds of raw materials, the preparation of the raw materials, the temperatures, the aeration and the rates of feed and many others. All

those factors enter into the question of how quickly or how slowly you should feed the solution into the yeast.

XQ. 22. Suppose you were told that you were to have in the beginning a 12 degree Balling solution and that you were to start the process with a 1 degree Balling solution, and that after you were all through, the average Balling of the wort that you had used during this process was between 3 and 5?

MR. JOHNSON: You are not asking my question.

MR. PHILBIN: Well, I won't ask that question, then.

MR. JOHNSON: You mean average Balling in the fermenter during the propagation process?

MR. PHILBIN: I said twice, and very distinctly, the entire wort used during the entire process, and I did not mean the wort in the fermenter during the entire process was at a Balling of 3 to 5, which I understood was the question asked the witness.

XQ. 23. But, Mr. Feild, I repeat myself, I am not saying that the wort in the fermenter, during the time that the yeast is eating, it is at an average Balling of 3 to 5, but the entire solution used has an average of 3 to 5. Is that clear?

A. Yes, it is clear.

XQ. 24. Now, suppose you were told that, how much raw materials would you use? That is, how many pounds of raw materials, total raw materials?

MR. JOHNSON: May I ask are you letting the witness build this theoretical plant to accommodate any size he wants to now?

MR. PHILBIN: No, I should have said in a practical yeast plant.

A. I would have to know more definite figures.

XQ. 25. What, for example, Mr. Feild? Assume we are talking about yeast plants such as they are, in common use.

A. I have so far been given an assumption of making a 12 per cent. Balling solution. I would have to know how many gallons of that 12 per cent. Balling solution, for one thing, would be required, and you ask how many pounds of raw materials; I assume you mean soluble raw materials?

XQ. 26. Yes.

A. In making a 12 per cent. Balling solution, you would use twelve parts of soluble raw material and eighty-eight parts of water.

XQ. 27. Yes.

A. Giving a hundred parts, or 12 per cent. Balling solution.

THE REPORTER: Twelve per cent. or 12 degrees?

THE WITNESS: Either one, on the Balling scale.

XQ. 28. But how many pounds of raw materials would you use?

A. I would have to know how many gallons you wanted.

XQ. 29. Is there anything else you would want to know?

A. So far that is all.

MR. PHILBIN: That is all.

RE-DIRECT EXAMINATION BY MR. JOHNSON:

RDQ. 30. In cross-examination of you as Mr. Philbin's witness, may I ask you if the density in the fermenter during an addition process of the type he asked you about would indicate anything to the yeast manu-

facturer as to the growth requirements of the yeast being satisfied?

A. The density indicates the growth of the yeast. It tells a yeast-maker a great deal as to what is going on in the fermenter. That is his means of finding out what is going on.

RDQ. 31. If during the first hours of the process the density remains in the neighborhood of 1 degree Balling, what would you know as to the supply of nutrients for the yeast in the fermenter?

A. If the initial Balling is 1 per cent. or 1 degree, and I am feeding in a more concentrated solution, and if the Balling should remain at a gravity of 1 degree in the fermenter, the conclusion is that the growth of the yeast is in direct proportion to the amount of material added; that is, that the yeast is growing and consuming the material added; if there were no yeast growth, and you were adding a concentrated material your Balling would rise in direct relation to the amount of material added.

RDQ. 32. And it is a fact, is it not, that if your Balling should rise rapidly from 1 degree to 3 degrees during the first two or three hours, let's say, of your propagation, you would know as a yeast manufacturer that you were feeding that yeast too rapidly?

A. That is true.

RDQ. 33. And it is a fact also, is it not, that during these propagating periods the yeastmaker takes the density on the Balling scale of the propagating liquid each hour as a rule?

A. At least each hour.

RDQ. 34. And with a 1 degree Balling initial set in the fermenter, it is a fact, is it not, that the density of the propagating liquid in the fermenter, if the yeast is fed in accordance with its growth requirements, remains around 1 and then gradually rises up due to the increased yeast content to around 2 or 2½ at the end

of the propagating period, assuming 14-hour fermentation?

A. You said if the yeast is added, I think.

MR. WATSON: If the——

A. That's right. There is an increase in the Balling reading due to an increase in the yeast content.

RDQ. 35. Even though the addition is proportioned correctly to the growth of the yeast?

A. Yes, you have to allow for that.

RE-CROSS-EXAMINATION BY MR. PHILBIN:

RXQ. 36. Do you also have to allow for increase in the amount of soluble salts and other materials that are set free during the propagation?

A. You have to allow for everything; in other words, solids will give you a reading on the Balling scale as well as dissolved materials, suspended particles of yeast will give you a reading.

RXQ. 37. And are there such solids in the wort?

A. Only yeast. That is, the others are in solution, suspended particles, I might say, of yeast.

MR. JOHNSON: Pardon me for interrupting. I believe that the difficulty might be in that you have been talking about the wort, etc., and have never given the witness, as far as I know, any particular nutrient solution that you are asking about.

RXQ. 39. You have been telling us what you have found to be true of worts in your experience, and as Mr. Johnson states, you have not yet told us what kind of worts those were. What were generally the materials used in those worts?

A. In my experience?

RXQ. 40. Yes, the worts you have been talking about.

A. He didn't specify any particular raw material. It isn't necessary that any particular raw material be specified. Anything that will dissolve in water will show a reading on the saccharimeter scale. In fact, we never

speak of the per cent. Balling as being per cent. sugar, we always speak of it as per cent. dissolved solids, which are often other than strictly sugar materials.

Some of the other solids that are in the wort or solution and which in addition to sugar will affect the reading on the Balling scale are, for instance, peptone solutions which will show you a reading on the saccharimeter scale and may have very little or no sugar. Yeast alone will give you a reading on the Balling scale which has no dissolved solids at all. Also soluble salts will.

MR. PHILBIN: That is all.

ARTHUR B. LAMB, resumed.

DIRECT EXAMINATION BY MR. WATSON:

Q. 365: Dr. Lamb, there has been some testimony offered by the defendant that alcohol may be blown from the fermenters during yeast manufacture. Turning to Plaintiff's Exhibits 13, 14 and 15 and defendant's processes shown by them, please explain the reason for the substantial absence of alcohol at the end of the procedure.

A. In these operations which are described in the exhibits you mentioned, as I have before testified, the Zulauf process is followed, or a modification of it, and the fact that no alcohol is formed or found in the final product in substantial amount, is due to—or I can put it this way, that the successful operation of these procedures is due to two primary causes: in the first place, the regulated feeding of this Zulauf process has prevented the formation of more than minute amounts of alcohol, and, secondly, if such minute amounts are being formed they are being substantially consumed by the yeast so that the high yields which these processes, relatively speaking, have secured, are to be ascribed primarily to these two advantageous arrangements or causes.

In my opinion the substantial absence of alcohol in the operations, records of which are on the mash sheets, is not attributable to alcohol having been blown out of the fermenter in substantial quantities. I am convinced that no substantial amount of alcohol has been blown out of the fermenter.

I heard the testimony of Mr. Luce regarding the alcohol tests on plaintiff's commercial Zulauf processes and on the comparative blank test containing similar small amounts of alcohol without yeast being present. My conclusion from those experiments, as I heard them recounted, is that the yeast did assimilate substantially all of the alcohol that was formed.

Q. 369. In testing solutions of such alcohol concentration as referred to by Mr. Luce or as encountered by these manufacturing processes, what have you to say as to the degree of accuracy of measurement by the pycnometer?

A. The pycnometer is an instrument that is capable of high accuracy and as employed in tests of this kind makes it simple to secure an accuracy of one or two units in the second decimal place of percentage, that is to say, an accuracy of one or two hundredths per cent., so that entirely adequate figures may be obtained for the concentration of even so dilute an alcohol solution as is here involved, by means of this instrument in the hands of a competent chemist.

Just as an aside, I can say that I have used pycnometers in the laboratory and determined densities of liquids such as these alcohol solutions, in which I have been able to be sure not only to the second decimal place but to the fifth and sixth decimal places.

It is true, however, that very considerable precautions have to be taken over and above what are used in the ordinary commercial procedure.

Q. 370. Will you refer to the book of prior art, Dr. Lamb?

I want to ask the witness a question or two on the Lavedan U. S. Patent 1,201,062, with a reservation of our objections to this reference, or to its admissibility because of its late date. Even its filing date is about a year after the dates of invention to which the Hayduck patents in suit are legally entitled, we think.

Q. 371. Does this patent, in your opinion, make any disclosure of the use of inorganic ammonium salts as a substantial nitrogen source, together with the use of a neutralizing medium to prevent the appearance of deleterious acidity?

MR. PHILBIN: Perhaps I can save time, your Honor. That patent was not offered by defendant as showing the use of any neutralizing agent.

MR. WATSON: You need not answer that question, then.

That patent, according to my list, as referred to by defendant's counsel, was cited against the '103 patent in suit.

MR. PHILBIN: That is quite correct, but it has no neutralizing agent, such as aqua ammonia or calcium carbonate. It merely has molasses, or grains, and inorganic ammonium salts.

THE WITNESS: In the first column on page 2 of the Lavedan patent there is a reference to settings of a solution of 8 to 10 Baumé. That is another scale of density.

Q. 373. About what does 10 degrees Baumé correspond to in terms of Balling?

A. I can't give you the corresponding figures from memory.

MR. WATSON: Can we agree on that?

MR. PHILBIN: If Mr. Johnson or Mr. Watson knows what it is, I am perfectly willing to have them state.

MR. JOHNSON: We can supply it and put it in the record, with your permission, if that is all right.

MR. PHILBIN: Perfectly all right.

This patent does not show any dilution of the nutrient solution in the propagation tank D in the figure by addition of added material other than what might be produced by an attenuation of the wort by the growth of the yeast.

The Polsky British patent does not show any regulated addition of nutrients in the sense that I have stated was disclosed by the Hayduck Patent '105. Neither does the Lavedan patent which we just passed over.

MR. WATSON: It is my understanding, Mr. Philbin, that you made no assertion that the Polsky patent shows inorganic salts plus neutralizing medium. Is that correct?

MR. PHILBIN: That is entirely correct, your Honor, if with the same meaning of neutralizing agent; that is, some antacid substance, such as calcium carbonate, or some basic or antacid substance containing or supplying nitrogen. But I do not wish it to be understood that with respect to such patents as Polsky, which describes the use of molasses and grains, I consider there are not in those substances these buffering materials, these substances which are naturally in the molasses and grains and which have some effect to counteract acidity; but with respect to having some neutralizing agent as we have been talking about, it is not defendant's position that that is taught by the Polsky patent.

THE WITNESS: Referring to the paragraph beginning line 10 of page 3 of the Polsky British patent, the

patentee does not make any distinction for the purposes of his process between carbonate of ammonia and sal ammoniac. He apparently treats them as equivalents, because he says, in lines 14 and 15: "I add the same quantity of carbonate of ammonia $(NH_4)_2 CO_3$ or of sal ammoniac (NH_4Cl)." These substances, of course, differ in that one has decided neutralizing power; while the other has relatively slight.

(Demonstration by the witness Lamb.)

This, your Honor, is a sucrose solution 12 degrees Balling, and I will take out of this reserve solution, measuring it out in what would represent the reserve tank—that is 100 cc.—another 100—50—making a total of 250 cubic centimeters. Just to demonstrate the Balling of this solution, I will use this same vessel as a container and take one of these spindles that will serve as a means of determining the density of the solution by how high they float. I will lower it into the solution and it oscillates up and down—you see that is 12 Balling—up and down just to the surface. That reads off then on the scale 12, showing that it was indeed a 12 degree Balling solution. Then to be very precise one can notice the temperature and on appropriate correcting tables allow for the slight difference in temperature and so on. For all practical purposes that is 12 degrees Balling. Now I will return that to the tank which contains the reserve solution. Now I am going to prepare the diluted solution——

THE COURT: 1 degree Balling?

A. (Continuing.) 1 degree Balling—and here is the fermenter in which that is to be prepared. I am going to take 65 cubic centimeters of this concentrated solution—as I have reckoned this out in advance, as you know, to fit the 3 to 5 rule; there is 65 cubic centimeters—put that in the fermenter, and then I will dilute this

volume of water, so that alltold we will have twelve times the volume. I therefore measure out eleven times the 65 or 715 cubic centimeters of water—we have distilled water so that it will be nice and clear and clean, as you will see—730—that is a little too much—well, that is very near 715 cubic centimeters. Adding this to the 65 will give me a total of 780 cubic centimeters of this diluted wort, and if my computations are correct this should be 1 degree Balling. We can test that by first stirring this up so it is thoroughly mixed, pouring a little into this vessel for a convenient way of measuring it.

You see, that is a much thinner wort, much lighter, the spindle goes down much lower; and if you will examine it, you will find that evidently the arithmetic was correct, because it balances at 1 degree Balling, as closely as one can see.

I will return this portion to the fermenter.

Now, in the yeast manufacture, of course, we should proceed with the addition of the concentrated wort, a little at a time, after this had been seeded and with aeration, feeding this in as the yeast grows to maintain nearly a constant Balling, about 1 degree, so that we know that the yeast requirements of the growth would have been met; and after a number of hours we should harvest the yeast. But I now want to show you that we are within the rule, because I will now do what the patent suggests—namely, that by mixing these together, the entire wort would have a mean Balling of between 3 and 5. So we can do this now physically, although the yeast-maker wouldn't bother to do it, he would depend on his arithmetic—we will just mix these together. You will see the concentrated wort going into the dilute. We will now stir that up to get it uniform, take a fresh tube, transfer a portion to it for test and, if you will recall, the calculation showed about 3.1 Ball-

ing. That is a little full (the witness emptied a portion of the liquid from the tube.) That is 3.1, as near as you can get it.

THE COURT: That is about perfect.

THE WITNESS: So that mixing together the entire wort gives the 3 degree, 3.1 Balling, as the arithmetical calculation in advance showed us would be the case.

By MR. JOHNSON:

Q. 380. Now, will you please make up a 250 cc. volume of wort at 12 degree Balling again, and take out only 10 cc. of that instead of 65, then dilute that to 1 degree Balling, and make your calculation, tell us what your final result would be, and mix the two together.

MR. JOHNSON: This is merely for the purpose of showing, your Honor, that, as I said this morning, you can choose any amount you want and arrive at any mean Balling you want, by calculation in advance.

MR. PHILBIN: I would like to know what pertinence that has.

THE COURT: It is repetitious matter, isn't it, just going over what you have already done in a little different way?

THE WITNESS: Well, your Honor, I think I can explain what he has in mind, because he told me outside. He has in mind showing what would happen if a plant didn't observe the rule; if he just took too small an amount of the reserve wort and diluted it up, without adhering to the rule. In other words,——

THE COURT: Well, that would change your Balling right away, wouldn't it?

THE WITNESS: Yes, it would; you can see that one could very easily go wrong.

MR. PHILBIN: Well, I think we can admit that.

MR. JOHNSON: Will you allow him to put the figures in the record then, just to save time?

MR. PHILBIN: Oh, surely, surely. I have no doubt that Dr. Lamb has calculated it correctly.

THE COURT: That seems to me to be self-evident.

MR. JOHNSON: I think so.

THE COURT: In view of what we have had demonstrated here, there can be no question.

THE WITNESS: Well, I think, your Honor, that one thing will appear more clearly from that repetition, I must say, than it can be said in words. I think you will see in a pretty clear fashion the disadvantages of failing to observe the rule. I am not doing it again to check my arithmetic.

THE COURT: You mean the rule——

THE WITNESS: Has real merits, as will appear from this.

THE COURT: What do you mean by the rule?

THE WITNESS: Selecting your mean Balling within 3 to 5.

THE COURT: Within 3 to 5?

THE WITNESS: Yes. That is, I am not doing this or proposing to do it to check my arithmetic again, because I don't think there is much doubt of that.

THE COURT: All right.

A. You tell me when to stop pouring.

Q. 381. Hold it.

A. Now, this time we can imagine the operator didn't know about the rule, had not been instructed.

THE COURT: Now you are dealing with 12 per cent.

THE WITNESS: So far it is exactly the same, 250 cubic centimeters of the concentrated solution, 12 degrees Balling, but this time he is only going to take 10 cubic centimeters of that solution. I will do it roughly. He pours this into the fermenting vat and adds 110 cubic centimeters of water, eleven times the volume, to bring it up to the right 1 degree Balling. That again we won't do with quite such care as before, because it isn't important to check the arithmetic any more. But here, your Honor sees now that we have the dilute solution present in the fermenter but relatively little of it. We can now proceed with the yeast manufacture just as before; that is to say, we can feed this in at a measured rate.

THE COURT: You are feeding in a 12 degree Balling now?

THE WITNESS: Right; and we can do it carefully, and the yeast will grow; we shall be maintaining the 1 degree Balling; so far as that is concerned, everything is all right; but here is the entire wort, and if I take the density of that I will find that it is 8.3, way outside the rule. That wort will be too concentrated at the end of the propagation, too much salts in it, too great a crowding of the yeast, so that that propagation doesn't take place as advantageously in that. Moreover, the yeast-maker has only utilized about a third of the contents of the fermenter. He has all that waste space (indicating). So that it is perfectly clear that by failing to observe the rule and selecting

his quantities ill-advisedly, and in view of that rule, he no longer realizes the full advantages of the patent.

MR. PHILBIN: I suppose if he used a smaller fermenter he wouldn't waste that space?

THE WITNESS: Sure, he could use a smaller fermenter.

THE COURT: But that wouldn't change the Balling?

THE WITNESS: That wouldn't change the Balling.

THE COURT: You say this ought to run about 8 now?

THE WITNESS: Yes.

MR. JOHNSON: 8.3.

THE WITNESS: 8.3. It is about 8. I didn't add it with great accuracy.

THE COURT: Well, that is near enough.

THE WITNESS: Yes, that is as near as you can get it.

THE COURT: Where is there anything in the disclosure of '105 which advises you as to the quantity of water to be used?

THE WITNESS: That is the very rule we are speaking of. It will tell you the quantity of water if you know the size of your fermenters, and you can tell from the rule just how much to take. That is the way I decided it this morning. I selected a 10,000-gallon fermenter, and adjusted my amounts to the size of the apparatus available in that factory.

If a man had three fermenters he could use three times as much only he would feed from this reserve tank to all three of his fermenters.

By THE COURT:

Q. 382. In other words, the formula requires something more than is stated in the patent itself, you must have some knowledge as to the liquid content of the fermenters?

A. You must know the size of your fermenters, that is to say, the yeast manufacturer is assumed to know it.

Q. 383. And that is a thing, you say, that is assumed on the face of the patent?

A. Yes, every yeast manufacturer will know the capacity, the size of his fermenter; he will know the cubic contents of his fermenter. I don't believe there is a yeast manufacturer that does not know that; if there was, I don't think he would manufacture yeast very long commercially.

THE WITNESS: The Swiss patent to Pollak in the exhibit book offered by defendant discloses lactic acid souring. It discloses means for effecting a great deal of that souring. It secures a repeated souring of the lactic acid wort, the wort to be used for the manufacture of the lactic acid.

Q. 386. As the lactic acid forms during the souring or when the souring has gone to a certain extent, does the patentee propose to introduce something so that it may be resumed?

A. Yes, the patentee at intervals adds a neutralizing agent to destroy the lactic acid as such, converting it into the salt of lactic acid and thereby brings about a renewed fermentation and produces more acid. This process, therefore, is for the production of an increased amount of lactic acid in the souring mash.

This patent deals, so far as I refer to it, so far as the souring of the neutralization is concerned, with a pre-treatment of materials before any yeast manufacturing operation. It describes the preparation of one of the raw materials that is to be utilized in the manufacture of yeast at a later stage.

Q. 388. On pages 233 to 235 of the record defendant's witness, Dr. Rautenstrauch, expressed the opinion that the yeast industry continued to use straight-set high Balling mashes for 35 years or more prior to Hayduck's inventions patents in suit, particularly '105, because until 1915 the operation which is patented and which is the subject of this suit, would not have been useful and that it became useful in Germany on account of the war and in the United States on account of Prohibition. Do you agree with Dr. Rautenstrauch's conclusion?

A. No, I cannot believe that. The great advances which these inventions made possible in yeast manufacture had a utility and have a utility wholly independent of their utility during the war or during Prohibition. Of course, it is evident that if that were not the case these patents would not have,—or the processes using these patents would not have been carried on subsequent to the war or subsequent to the repeal of Prohibition. The patents recorded a real technical advance which made them valuable, irrespective of those special factors which were operative during the war and during Prohibition.

Turning to the Austrian patent to Fritsche. This patent mentions the use of ammonium salts but I cannot find any mention of any neutralization of the resultant deleterious acidity in the propagation of yeast. The patent does not show any regulated in-feed of the reserve wort during the propagating period or the fermenting period.

Q. 392. Refer to the abstract from The Brewing of Wines and Spirits from the Journal of the Society of Chemical Industry of 1908, page 415. This, it has been testified to, is an abstract of an article written by Henneberg and appearing in the Wochenschrift fur Brauerei in 1908. Did you read the original of that article?

A. Do you refer to the original article in the Wochenschrift?

Q. 393. Yes.

A. Yes, I have read it and I have read it repeatedly. I don't remember the number of pages in the article, but it is long. I should think it was about 30 pages. I had occasion to study that reference in the suit on certain of the patents here in suit against the Federal Yeast Corporation. I studied it at great length and with great intensity. It was very complicated, a host of tables recounting thousands or at least many hundreds of experiments on the behavior of yeast under the greatest variety of conditions, almost all on quite a minute scale, laboratory experiments, but most complicated in its general results.

Q. 398. The third numbered sentence under the heading on page 224 of the Pure Foods Magazine states:

"3. Not toxic in hydrant water (of the Institute) with sugar."

The numbered sentence or phrase in the abstract of the article in Journal of Societe of Chemical Industrie reads:

"3. Non-poisonous in supply water;"

Do these conclusions mean the same thing?

A. They mean very nearly the same thing. The words in the parenthesis, of course, in the English, do contribute the additional information that the hydrant water or supply water referred to was the water of the Institute, supplied to the Institute; but I should state

that that is the only difference. I don't know that that is a significant difference, I don't think that it is a significant difference.

Q. 399. Dr. Rautenstrauch expressed the opinion that the conclusion of this third section was a correct one. What would the significance of that be to a yeast manufacturer?

MR. PHILBIN: I am not sure that Dr. Lamb has testified that he is a yeast manufacturer or has ever been engaged in the manufacture, practical manufacture, of yeast.

MR. WATSON: I can qualify the question, as I thought it went without saying, that I am asking for the witness' opinion.

MR. PHILBIN: But not as a yeast manufacturer.

MR. WATSON: Opinion as a patent expert, as to what it would mean.

A. The inference certainly would be that the nitrogenous substances listed in the preceding paragraph would not be poisonous to yeast in solutions containing sugar in ordinary tap water or commercial water, hydrant water, because he would know, if he read Henneberg's article, that Henneberg's conclusions were all based on rather artificial conditions, the small amounts of these solutions, and maintained for long periods of time; his experiments often extended over many days, almost months, and he was concerned only incidentally and partially with the increase in yeast; it was only one of dozens of other observations he made on these minute samples of yeast in these little vessels. So whether a yeast manufacturer could draw any important conclusions from these experiments with regard to his own operations I very much doubt.

In most of Henneberg's experiments, practically all of them, he used distilled water, but occasionally, as in this very citation that you have called to my attention, he used ordinary tap water. Ordinary tap water or supply water commonly contains slight amounts of lime salts.

Q. 402. Dr. Rautenstrauch, defendant's witness, in speaking of the Roth French patent, 470,925, was asked what the word "must" meant in the sentence: "When one makes use of mineral acids exclusively, the purified molasses is placed directly into the fermentation vat and is made to ferment with clear nitrogenous extracts, vinasse nutritive salts, etc." He replied that "Must is a material which is recovered from fermentation; it is a sort of muck, it has certain values in the nutrient solution."

What do you understand "must" is?

A. Why, I understood it was the nutrient solution. I must admit I meant to look that up in the dictionary, because I was surprised at this interpretation of Dr. Rautenstrauch's. I feel that that can't be correct. But I would like to look it up in a dictionary to be absolutely sure. That is not my understanding of it.

By The Court:

Q. 403. May I interrupt while you are looking up that word? You remember, Doctor, that when you finished the experiment I asked you whether or not you came to the 3 degree-5 degree Balling conclusion, because you took into account the size of the fermenting vat used, and it is upon that basis that your answer set forth in P-19 is mathematically calculated. Would it not be necessary also to take into account in feeding the yeast from the 12 degree Balling solution the rate of consumption manifested by the yeast itself? Wouldn't that also be a necessary factor before you could be certain as to the mathematical calculation, regardless of the size of the fermenter?

A. No, the rate of feed and the phenomena of yeast growth have nothing to do with the selection of this quantity; this is all antecedent to the yeast growth. It is simply——

Q. 404. Well, it is obvious, is it not, that if you put a solution into that yeast faster than it can consume it that you would have at the end something more than 3 to 5, as was demonstrated by your experiment here showing 8 degrees of Balling?

A. No, your Honor, we don't ever get 3 to 5 nor do we ever get 8 in yeast manufacture; we get 1 degree Balling in yeast manufacture. The only object we had for putting those solutions together and getting 3.1 for the combined value or 8 in the improper arrangement, was to show in reality what we had done by calculation. In the yeast manufacture that is not ever done and the rule specifically puts it in the conditional; that is, the mean content "would be." Of course it isn't because it isn't done.

By Mr. Watson:

Q. 405. But the rule is used?

A. The rule is used but the actual mixing of the entire wort to get the mean Balling isn't ever done, it is not necessary to be done. All that is necessary is to make the calculation. We perform the mixing to make it more evident visually.

By The Court:

Q. 406. But you had to have something to start with, and one of the factors put in was not specifically mentioned but it is assumed by one versed in the art when he reads the patent, and that is the liquid content of the container?

A. Absolutely correct, that is true.

Q. 407. And that is pretty close?

A. Yes, that is absolutely correct.

Q. 408. One other thing: It is obvious to me, as I visualize the process, that if you took that 12 degree solution and fed it in at a greater rate than the yeast would consume it down to 1 degree allowance, that you could not then, by mathematical calculation, come to your 3 degree-5 degree wort?

A. No, the calculation has nothing to do with that stage of the process, that has no bearing whatever. All you do—your Honor is entirely correct—if the Balling of the solution changes, if it goes below 1, you just speed up the feeding.

Q. 409. Isn't it just as much dependent upon the ability of the yeast to consume the wort as it is on the size of the vat?

A. That has nothing to do with the size of the vat, your Honor, this feeding in.

Q. 410. Well, it does when you make your mathematical calculation.

A. To determine how much water and solution to take.

Q. 411. Well, then, do I understand the mathematical calculation has no bearing whatever on this thing? Then why are we considering it?

A. It has no bearing on the step of fermentation of yeast growth, it has a bearing in the preparation of the solution for that subsequent step. The yeast-maker has to know——

Q. 412. You see my difficulty is as a matter of logic and chemistry to find that the 3 degree-5 degree point means something, and if so what. If I find that it does mean something, then I can see some basis of reason for the 12 degrees with which you start, and I can follow through the processes. When you get down to the end of it and I want to bring myself to a 3 degree-5 degree conclusion, I find that this mathematical calculation fits nowhere except arbitrarily into the solution of

the problem, arbitrarily, because I say that you take an arbitrary figure, to wit, the size of the fermenter, and from it calculate a Balling degree measurement to be fed in.

A. May I add one point to that? The yeast-maker has to know the size of his container and he has to know the Balling of his concentrated wort. That 12 degrees is a usual Balling for such worts. It can be other Ballings. The patentee speaks of it as a typical or representative Balling and once he is given the Balling of his concentrated solution and once he knows the size of his vats, the rest follows unavoidably from the statements of the patent. The 1 degree Balling is the concentration of the dilute solution and the 3 to 5 rule in determining how much of that solution to take so nothing is left to chance and the optimum operation of the patent is secured.

By Mr. Johnson:

Q. 413. Dr. Lamb, isn't that rule somewhat similar to the proposition that the yeast manufacturer, having a plant of a given size, has to determine how much mash he is going to make to run through there?

A. Certainly.

Q. 414. Selecting the number of bushels of corn——

The Court: Isn't it equally important for him to know the rate of consumption of the wort by the growing yeast?

Mr. Johnson: That is handled in a subsequent stage, and when he uses this 3 to 5 Balling rule to set his fermenters——

The Court: Let us look at the patent a moment.

Mr. Johnson: Mr. Watson suggested, your Honor, that it might be helpful to you if each side

should submit a short memorandum before the next session, setting forth their position and their reasons for it, sticking to the record as far as possible at this stage of the case.

MR. PHILBIN: Nothing complicated nor difficult about it from the point of view of the defendant, your Honor. We feel that the all-important thing when you are feeding yeast just as when you are feeding a plant or feeding an animal, is the rate at which you give food to that animal. Now, as I understand it, Dr. Lamb has said these complicated calculations have nothing whatsoever to do with the rate at which you are feeding this yeast, which we think is the all-important thing.

THE COURT: Then why isn't that surplusage, sir? Why does it belong in this patent? If it doesn't prove anything, why have we got it here in the patent?

MR. PHILBIN: That is what we do not know, your Honor; as far as we are concerned, the defendant, it is surplusage. It means nothing. It is not in the claims, there is nothing in the claims about it, your Honor, and we don't know why plaintiff is placing all this stress upon this particular matter.

THE COURT: Of course, if it is a matter of mathematical calculation anyone can take a certain premise and if he knows, for instance, that he wants to arrive at a conclusion he can arrange digits to make ten, can't he? So in this experiment that I have had here today. We look at this thing and we find we want to make 3 degrees to 5 degrees Balling, and of course we arrange digits so as to make it.

MR. PHILBIN: Exactly.

THE COURT: What does it prove? That is what I want to know.

MR. WATSON: The patentee, if the Court please, has got to instruct under the statute, got to make a disclosure. The statute requires the patentee to instruct the art as a condition of the grant. Now, this patentee instructed the little manufacturer as well as the big manufacturer, all of them, and he instructed them in two respects on this point. One of them he instructed how to set up his materials to start and that is the rule——

THE COURT: You see, I get right along with you absolutely down to a certain point.

MR. WATSON: Then he told them in another place in the patent how to proceed with his yeast manufacture from that point. That is another part of the patent. This instruction refers only to telling him how to start. The other part of the specification tells him how to proceed from there on. Now, the significance of the dispute between the parties, I think, is that defendant's witnesses say this paragraph deals, not with the starting instructions but with the manufacturing procedure instructions, and that we deny and we shall prove it.

MR. PHILBIN: Mr. Watson says the plaintiff thinks that Mr. Hayduck is recommending a 1 degree Balling, or about that, while the yeast is getting the food. We think that Mr. Hayduck is recommending a Balling of between 3 and 5 degrees while the yeast is being fed.

THE COURT: Well, of course, he does say he starts with 1.

MR. PHILBIN: Yes, your Honor.

THE COURT: At line 66.

MR. PHILBIN: Yes, your Honor.

THE COURT: Or about there. Let's see. No, line 73.

MR. PHILBIN: Yes, sir; he starts with a 1 degree Balling and then he adds some more wort. The plaintiff contends that what the patent says is to add that wort so that there shall always be about a 1 degree dilution in the wort which the yeast is eating. We think the language means that the wort, average wort, while the yeast is eating it, should be between 3 and 5 degrees.

MR. WATSON: Which is a repetition of my statement, that it is defendant's position that this language concerns the rate of feed during yeast manufacture. We deny it. Our position is that that language deals with the preselection in preparation to begin.

MR. JOHNSON: If your Honor please, the direction for beginning with the 1 degree Balling in the fermenter is in the middle of the second column of page 1 of the patent, and down at the bottom of both the first column and the second column the inventor directs, in the first column, that you shall use very low concentration of sugar—that is Rainer, I beg your pardon, that is Rainer. Down in the second column it says the yeast is constantly given new supplies of all——

THE COURT: What does crowding have to do with the problem here? You see, I made a note when Dr. Lamb first testified that from line 90 to line 95 "more particularly against crowding." There we were concerning ourselves with the feeding-in process.

MR. JOHNSON: Crowding, yes; and Dr. Lamb told your Honor while he was running the last experiment, that if you began with too small an amount——

THE COURT: Now, if that is to prevent crowding, why doesn't he say 1 per cent. there instead of 3 to 5—or rather 1 degree instead of 3 to 5?

MR. JOHNSON: All right.

THE WITNESS: Exactly.

MR. JOHNSON: Dr. Lamb explained to your Honor, I believe in the last experiment that he ran, where he didn't get, intentionally didn't get, a 3 to 5 Balling in his mean value, that if you began with that small amount of dilute wort of 1 degree Balling, as he tested, you would feed in your concentrated nutrient solution and keep your Balling in the fermenter the same as you did in the other process, 1 degree, but that in order to utilize this residual mass of concentrated wort, the yeast would be apt to grow and grow and grow, and the volume of solution was so tiny, comparatively speaking, that it would be overcrowded in there. So that is what this 3-to-5-rule has to do with. It means to take such an amount of dilute wort, to begin with, that you have a large batch of 1 degree Balling in the fermenter, and then pour in what amounts to a smaller fraction of the concentrated wort, so that all that sugar is grabbed up and made into yeast, and yet the yeast is not overcrowded.

THE COURT: Now, when you get through with that, according to the run of manufacture, and before you can ever do anything, demonstrate anything, as I see it at the moment, you have exhausted your entire 12 per cent. solution by feeding it in slowly to the 1 per cent. solution?

THE WITNESS: Right.

THE COURT: Therefore, it leaves this mathematical calculation with no bearing on the proposition at all, as I see it.

MR. WATSON: The mathematical calculation, as I said, was the selection of your starting materials, you have got to take this, that, and the other thing, to get yourself ready.

THE COURT: Well, isn't that really a proposition where you sit down and look at somebody's work and say "How did he possibly get this 3 to 5 in there?" and you sit down, piecing out the crossword puzzle, until you finally hit it, and it is purely arbitrary when you hit it that way. Then, when you look at your mathematical calculation, you say, "What in the world has that to do with this feeding of yeast?" Nothing. It has nothing to do with the feeding.

MR. WATSON: It has nothing to do with the feeding, with the rate of feeding. It has a great deal with do with the yeast manufacture.

THE COURT: Now, let me get another thing clear about it. We have put in a lot of time today on that, it is very interesting to me. We are dealing with it in the specification. When you get all through with it, the specification is simply for the purpose of enlarging or diminishing the claims but to give us perhaps a key to open the meaning of the claims. Now, when we go back to claim 4 it reads as follows:

"A process of propagating yeast with a relatively low yield of alcohol which comprises preparing a wort containing all essential yeast nutrients in solution, initiating propagation of yeast in a diluted portion of said wort, aerating the diluted

portion, and substantially continuously adding during the period of propagation, a wort of higher concentration, at a rate such that the yeast may propagate and substantially all of the alcohol which may be formed is assimilated by the yeast."

Looking at that, then, and comparing it with the disclosures in the specification—as I understand it, that fourth claim has been sustained in prior litigation.

MR. WATSON: Yes, sir.

THE COURT: It would seem to me that all the Court is concerned with here is whether or not, dealing now with the question of the validity of the patent, that fourth claim is sufficient to do what is claimed. Now, to demonstrate that, we go back, then, to the specification, and that particular part of the specification is the only particular part of the specification which acts as a key to unlock this fourth claim. And looking at it we find that we have got to give meaning to all of its words. We come down to the 3 degree-5 degree Balling and we find what? Is that surplusage in there?

MR. JOHNSON: It certainly is, and the witness, Mr. Feild, said that if you fed——

MR. WATSON: Surplusage? No.

MR. JOHNSON: Well, maybe I misunderstood your Honor's question. I thought your Honor asked if you had fed your reserve nutrient solution so fast that you had a 3 to 5 degree Balling in the fermenter——

THE COURT: You couldn't get that if you did what claim 4 provides.

MR. WATSON: That is exactly plaintiff's position.

THE COURT: You couldn't get any such thing as 3 to 5; because he says in his claim 4: "continuously adding during the period of propagation, a wort of higher concentration, at a rate such that the yeast may propagate and substantially all of the alcohol which may be formed is assimilated by the yeast."

That isn't what I meant. It was another part of it.

"Which comprises preparing a wort containing all essential yeast nutrients in solution, initiating propagation of yeast in a diluted portion of said wort, aerating the diluted portion, and substantially continuously adding during the period of propagation a wort of higher concentration."

That is our 12 degrees.

"at a rate such that the yeast may propagate."

Now, yeast won't propogate unless it consumes, and I assume if you put too much in you strike the rule of diminishing returns and destroy your yeast. You have got to strike that putting in correctly in there, have you not?

MR. WATSON: That is correct; otherwise your yield and quality will suffer.

THE COURT: Now, I am having difficulty—— I am speaking as though I were finally deciding something but I want you to understand, gentlemen, I am merely reasoning aloud for the purpose of showing you the great difficulty with which I am confronted in endeavoring to solve this thing, and when you come in with your final arguments, you will know some of the things that are in my mind, and perhaps save me mental torture.

Let's see, the other doctor isn't here today, is he, Dr.——

MR. PHILBIN: Rautenstrauch?

THE COURT: Yes.

MR. PHILBIN: No, your Honor.

THE COURT: He won't be back, then?

MR. PHILBIN: He may be back on Tuesday. This claim 4, your Honor, as I think may be admitted, does not contain anything with respect to the average of the wort that is used, and these calculations all deal with the average of the total wort. This claim merely says you start with dilute, 1 degree, and then you add more, such as 12 degrees; but there is nothing in this claim, and, as we think, in the real substance of the patent, whatever it may be, which has to do with all these preliminary calculations.

THE COURT: Well, I find in reading Judge Soper's opinion at page 331——

MR. WATSON: I want to call your Honor's attention to that second paragraph on that page also.

THE COURT: He apparently didn't go into what we have been discussing here at all, did he?

MR. PHILBIN: No.

MR. WATSON: If your Honor will read the second paragraph on the page you will find something more there.

MR. PHILBIN: I do not believe this point was discussed much, if any, your Honor, before Judge Soper, for the probable reason that it has no real importance.

THE COURT: Well, just let me read aloud, and you will have the benefit of what I am thinking of. "Patent '105."

"The important feature of the process disclosed by this patent relates to the method in which the mash or wort is introduced into the propagating vat. A feeding process, referred to in the testimony as the Zulauf feed, is prescribed, whereby a comparatively small part of the nutrient solution is diluted, placed in the vat and seeded with yeast,"

Now, that is the one degree; we have got that in this case.

MR. PHILBIN: Yes.

THE COURT: (Continuing.) "and, after it has begun to grow and propagate, the remainder of the wort is fed in gradually to supply its increasing needs."

That means the 12 degrees being put in.

MR. WATSON: At a certain rate.

THE COURT: At a certain rate.

"As we shall see, this change has been accompanied by a great increase in the yield of yeast from raw material in the modern yeast factory.

"The experts now agree that, in the growth of yeast, it is desirable to have neither too much nor too little of the necessary foods. During the propagating period, the microscopic organism of yeast grows to a certain maturity, and then divides or splits to form additional cells, so that under ideal conditions there is a progressive geometric increase in the number of cells until all the nutritive value has been consumed. It is obvious that, unless sufficient food is produced for the growing organisms, they cannot thrive to the best advantage. On the other hand, it is equally important that not too great an amount of food be introduced. There must be sufficient space in the propagating

vat to enable the respective cells to reach maturity without undue interference with each other; for it is known that, in the course of growth, the cells excrete alcohol and carbonic acid gas, which have a poisonous effect when present in too great quantities upon other cells in the neighborhood. Furthermore, it is equally well settled that too great a supply of sugar material will bring about the production of more alcohol than the yeast can assimilate and thereby retard the growth of the yeast. It has been picturesquely said that the Hayduck procedure avoids the extremes of feast and famine, and that it aims to maintain throughout the period of propagation an optimum concentration of materials.

"The specification expressly declares that the patent relates to a low-alcohol yeast process. Prior workers in the field, it is admitted had already pointed out that, to accomplish this purpose, the wort should be diluted to such an extent that the alcohol produced from the sugar could be assimilated by the yeast as nourishment. It had also been disclosed by the Rainer patent, hereinafter discussed at length, that one method of achieving the desired result was to add the peptone (nitrogenous material) continuously, and the sugar at intervals as required. The particular method disclosed by the Hayduck specification is substantially as follows: A wort having, for example, a gravity of 12° Balling is prepared according to the procedure commonly followed in the industry. A part of the wort is placed in the vat and highly diluted, for example, to about 1° Balling. Seed yeast is added and aeration follows. Thereupon the remainder of the concentrated wort is added slowly and substantially continuously at such a

rate that the alcohol formed in both portions of the wort."

Now, I don't understand just what he means by "both portions of the wort." A wort isn't divided into two portions.

MR. WATSON: He means the portion that was in there at the start and the portion that is fed in, after it gets in.

THE COURT: "Thereupon the remainder of the concentrated wort is added slowly and substantially continuously at such a rate that the alcohol formed in both portions of the wort——" I don't see what he means by "both portions of the wort" —"both portions of the wort is immediately assimilated by the yeast. The quantity of the diluted wort originally placed in the vat is so chosen that the mean content of the entire wort would be from 3° to 5° Balling." Now, there are two things I would like clarified here. First I am confused on the question as to what is meant when the Judge says "at such a rate that the alcohol formed in both portions of the wort is immediately assimilated." Both portions. Now, according to what he said there he is apparently following closely the specification read in connection with the claim. He is disclosing, for example, that we have a 1 degree wort into which there is being poured a 12 degree wort at a rate most advantageous to the growth of the yeast.

By THE COURT:

Q. 415. How can that be divided into two portions?

A. I wonder if he doesn't mean all portions. I think that is a slip because there aren't two portions there.

Q. 416. That is what I think, Doctor. I cannot make two portions there because the moment they are mingled it is one portion.

A. Certainly.

Q. 417. With the Balling instantaneously changed and then affected by the feeding of the yeast.

A. I think he must mean throughout.

Q. 418. Now we get down to the point we have had so much interesting discussion on today. He says: "The quantity of the diluted wort originally placed in the vat"—by vat he means fermenter, doesn't he?

A. Yes.

Q. 418. (Continuing.)—"is so chosen that the mean content of the entire wort"—Query: In the vat? Answer, yes—"would be from 3° to 5° Balling."

A. No.

Q. 419. Answer no. The entire wort he is talking about, two worts; of course, the entire wort doesn't mean the wort.

MR. PHILBIN: The defendant thinks, your Honor, the answer should be yes.

A. The entire wort, when he has spoken of two separate portions of the wort, evidently means the combined wort. I don't think there is any very——

MR. JOHNSON: Your Honor please, I think the most important portion of what you read of Judge Soper's opinion, as to that rule in relation to this particular problem before us, is that there must be sufficient space in the propagating vat to enable the budding cells to reach maturity or without undue interference with each other.

THE COURT: That is the crowding.

MR. JOHNSON: And if Mr. Philbin, who was counsel in that case, will permit me to say so, it is my belief that that holding there was based on this

same testimony of Dr. Lamb in that case about the importance of this 3 to 5 Balling rule, that is, the selection of the dilute solution.

THE COURT: Did Judge Soper have this problem before him, as to whether or not the 3 degrees-5 degrees was to be considered as the content of the fermenting vat, did he have that before him?

MR. JOHNSON: No, your Honor, he did not, and it is——

THE COURT: Well, isn't that the gist of this thing?

MR. JOHNSON: That is defendant's position, that that is so, but our position is that it could not be so to have a 5 degrees Balling wort in there in the fermenter because——

THE COURT: No, it is quite true that a practical manufacturer of yeast would look at that right away and say, "Why, of course, he starts out by saying in the beginning that the most advantageous Balling for the yeast is a 1 degree Balling. He winds up by saying that it ought to be a 3 to 5 degree Balling." That would be a contradiction on the face of it, wouldn't it?

MR. WATSON: Yes, sir.

MR. JOHNSON: Surely. And Mr. Feild says if you fed it so rapidly that the Balling increased from 3 to 5 you would be building up alcohol in there and that is utterly inharmonious with the last phrase of claim 4, which says, "so that the alcohol may be assimilated."

MR. WATSON: Your Honor's question of what was before Judge Soper may be answered this way, that Dr. Lamb was plaintiff's expert in that case and testified there as to the meaning of this

sentence as he has testified here before your Honor. His testimony in that regard——

THE COURT: Was not attacked?

MR. WATSON: Was not attacked. There was no suggestion to the contrary as there has been in this case.

(Recess.)

MR. JOHNSON: If your Honor please, on page 392 of the record there is a reference to 10 degrees Baumé, which occurred as the density figure in the Lavedan patent, and I was to find out what the corresponding figure of Balling was. The figure is 18 degrees Balling or thereabouts.

On page 404 of the record Dr. Lamb was asked about the meaning of the word "moût," a French word. Patterson's French-English dictionary gives the definition of that word as "must (of grapes, etc.;) brewing (wort)."

DIRECT EXAMINATION BY MR. WATSON (Continued):

Q. 420. Dr. Free testified regarding some experiments he conducted, particularly experiments No. 14 and 15, on the question of whether alcohol would be assimilated by yeast in the propagating vat while there was assimilable sugar also present. Have you examined Dr. Free's notebook entries of these experiments on that point?

A. Yes, I have examined them. I do not think that these experiments demonstrate what Dr. Free concluded from them. If I can have a copy of that exhibit I can point out one respect in which it seems to me this conclusion is unjustified.

(Exhibit handed to the witness.)

In Dr. Free's experiments 14 and 15 the determinations of the amount of alcohol in the wort at the end of the eighth hour showed, in experiment 14, which is

given on page 276 of the record, 0.107 per cent. of alcohol in the wort. In experiment 15, in which case alcohol was actually added to the wort in the feed, the average per cent. of alcohol at the end of the eighth hour was 0.2 per cent. At the end of the tenth hour the per cent. of alcohol in both experiments had dropped: In experiment 14 to .001 of a per cent., and in experiment 15, to .064 of a per cent. Dr. Free concluded from this, as I recall his testimony, that during this period alcohol was indeed consumed by the yeast, but during this period no addition of sugar was made to the fermenter. So that here was an instance, according to Dr. Free, of no consumption of sugar by the yeast, and a consumption of alcohol. I wish to point out that Dr. Free's own experiments showed in Table 4, at the bottom of page 52 of his notebook, that analyses were made of sugar in this wort during these intervals, and while there was a drop in the amount of sugar present at the tenth hour as compared with the eighth, there were still significant amounts of sugar present in this wort, and that therefore some alcohol was being consumed in the presence of sugar. Moreover, some of the sugar was consumed, because in every case there has been a drop in the sugar amount at the tenth hour as compared with the eighth. Then on the basis of these very experiments we see that at least some alcohol has been consumed during this period along with the consumption of some sugar, which is precisely the position that was taken by the plaintiff in this case, and is expressed in the Hayduck patents.

Q. 422. There was testimony by Dr. Free also that alcohol formed during such process of fermentation was not consumed by the yeast in the presence of sugar but that it probably disappeared by being blown out of the propagating vat. What is your opinion on that possibility or that explanation for the absence of alcohol?

A. I think that that explanation is inadequate and that the experiments which Dr. Free has described in his notebook must have involved some unsuspected error because I am certain that the amounts of alcohol which he reported as blown out of the solution could not have been blown out of these solutions under the conditions that he depicted. It is possible on the basis of certain and sure principles of physical chemistry to compute the maximum amount of alcohol that could have been blown out by the quantities of air which he employed and they are considerably less than the amounts that his experiments indicated. Of course, some alcohol is blown out even from these very dilute solutions but nothing like the percentages which Dr. Free has reported.

Q. 423. You have already stated that you testified on behalf of plaintiff in former litigation on the patents in suit in the District Court at Maryland. In connection with your testimony there did you also have tests made to determine this question of alcohol assimilability in the presence of sugar?

A. I did.

Q. 424. Have you a sheet here showing such a test?

A. I don't think I have that sheet.

Q. 425. Well, I find it.

Mr. Philbin: May it please the court, defendant objects to the introduction at this time by the plaintiff of additional evidence such as test sheets or testimony on the issue of whether or not, as stated in the Hayduck patent, the yeast does assimilate alcohol. That was a part of plaintiff's prima facie case. It was testified to by plaintiff on its opening case. Defendant has put in its evidence to rebut as it considers that testimony by plaintiff. It is not proper for plaintiff to hold back

a part of its evidence on this issue upon which it has the burden and thereby put the defendant in the position of not having any opportunity to rebut it. There is no difference between a patent suit and any other suit and the plaintiff is compelled, as a matter of fairness, to disclose fully its position on the various issues upon which it has the burden in its opening case and cannot reserve until so-called rebuttal some evidence which it had available at that time. Of course, it is discretionary with the court and if this particular evidence had been lately discovered we would not make any objection, on the assumption that we would have some opportunity to rebut it, but apparently this is evidence that was in the possession of the plaintiff; it was evidence that Dr. Lamb testified to in this other suit, and therefore we object to it coming into the case at this time.

Mr. Watson: Of course, if the Court please, the patent prima facie is valid as it stands and is entitled to that presumption on plaintiff's prima facie. It was not until the defendant put in evidence to rebut the statements of the patent that plaintiff was required or did offer——

The Court: Well, gentlemen, you needn't take up any further time on the subject. My feeling is that in a trial of this kind, perhaps more than any other, where we are engaged in a serious effort to understand intricate matters, to bring out the truth—I am not so much impressed with the technical rules or the ordinary methods pursued in offering evidence so long as the Court sees to it that both sides have an opportunity to fully present an answer to any new matter that may be raised. The motion is therefore denied. The

Court will allow the defendants to put additional testimony in on the subject we are now discussing.

Q. 426. I hand you a sheet and ask you if that has the data you have just referred to.

A. Yes, this describes the experiment which Dr. Schultz carried out at the time referred to. The experiment briefly was to replace a portion of the molasses in the molasses mash by alcohol and specifically in a mash containing 300 grams of molasses; 75 grams of this was replaced by its equivalent weight of ethyl alcohol, the alcohol here involved, and propagation of yeast run in both of these solutions under similar conditions and a yeast of substantially the same character and almost identical yields were obtained in the two cases. The yields obtained were such as could not have been obtained solely from the molasses present, so that the conclusion is inescapable that some of the alcohol must have been utilized in the propagation of this yeast.

(The sheet referred to by the witness received in evidence and marked Exhibit P-20.)

Q. 427. Dr. Free testified on the effect of what he called buffers in the molasses in the runs similar to defendant's commercial operations, and reported on certain tests he had made on that question, and expressed his conclusion. That conclusion, as I understood it, was generally to the effect that as much as 99.8 per cent. of the possible sulfuric acid to be released from the ammonium sulfate used by defendant was buffered by materials naturally present in the molasses. That testimony begins on page 385 of the record. Have you examined the data that Dr. Free offered in connection with his testimony?

A. Yes, I have. I have had tests conducted on that question also. The tests made by Dr. Free to which your question now relates were conducted so as

to bring out, if possible, the effect of the addition of ammonium lactate to a wort used for the propagation of yeast on the acidity which might develop in such wort due to the consumption of inorganic ammonium salts, like ammonium sulfate, by the yeast. To carry out this test, Dr. Free, on the one hand, added sulfuric acid in small amounts, in successive doses, to some of this untreated wort, in amounts which would correspond ultimately to the total amount of acidity that might have been set free from the ammonium sulfate which was to be added to this wort, and at the same time he took measurements or had taken measurements on the hydrogen ion concentration, and recorded these results in pH units. He then repeated this experiment, having previously added an amount of ammonium lactate corresponding to what was present in defendant's feed, and he found in this second experiment hydrogen ion concentrations somewhat less than in the case without the addition of ammonium lactate but not very greatly less, and he drew the conclusion that the difference was not significant. Now, I want to point out that while I do not question the correctness of these measurements as made, that the conditions selected by Dr. Free were such that the results he obtained were without immediate significance to the question at issue. In other words, that he selected conditions under which the efficacy of ammonium lactate could hardly have been expected to disclose itself. Putting it perhaps more specifically, he treated the problem from the point of view of the entire wort, the entire molasses, and the entire amount of ammonium sulfate that was to be used, and he utilized in this way the entire buffering effect, as he called it, of the molasses present in the wort, and he utilized it at a concentration which corresponds to the over-all concentration employed in defendant's wort. Now, as a matter of fact, both of these

conditions were entirely prejudicial to the experiment if it was designed to show the efficacy of ammonium lactate during the progress of the fermentation. The experiment should have been performed under the conditions that prevailed during the yeast growth, and particularly at that time in the yeast growth when it is known that acidity develops and when it is known that it is particularly harmful. He should have taken, let's say, the conditions in the fermenter at the sixth hour or thereabouts and then repeated his experiment with and without the addition of the prescribed amount of ammonium lactate. This he did not do. Had he done so he would have found very greatly increased acidities prevalent,—prevailing in the fermenter at the end of the sixth hour, and he would have found a very significant effect of the ammonium lactate in diminishing that acidity. Not only was the relative amount of ammonium sulfate present at the sixth hour as compared with the ammonium lactate present, significantly greater than Dr. Free employed, but the dilutions were considerably greater, the over-all dilutions at that time, and as Dr. Free's own experiment showed, the greater the dilution the less the buffering effect of the material in the molasses. My conclusion then is that Dr. Free's experiment conducted under the conditions that he chose is quite beside the point because it does not disclose as it should and as it would, if properly conducted, the significant neutralizing effect of ammonium lactate in worts of this character.

Q. 430. The experiments of Dr. Free which you referred to on the matter of dilution show, as I recall, dilutions of 40,000, 60,000 and 80,000. Do you know the dilution which is typically employed in defendant's processes shown by the exhibits at the end of the sixth hour?

A. I haven't that figure accurately in my head but it was something over 100,000.

THE WITNESS: After Dr. Free's testimony was completed and as soon as I had a chance to study these figures, I had experiments performed under what I considered the more legitimate conditions, as I have outlined, and I have a record here of what was done and of the results that were obtained. I have prepared a wort corresponding to that present in the propagating vat of M-177 at the end of the sixth hour without any souring and without the addition of any yeast. To one portion of this wort I first had added the amount of lactic acid corresponding to the initial acidities as disclosed by the titratable acidities given on the mash sheet. In Dr. Free's experiments he did not provide an excess of lactic acid at that point. I might have pointed out that that was an added blemish on the experiments although not so serious a one.

Q. 433. When you say blemish do you mean that that was another respect in which Dr. Free's experiment did not parallel the conditions actually encountered during defendant's operations?

A. Yes, that is what I had in mind. Perhaps the word was ill chosen but I cannot think of any other just this moment. I then had added the calculated amount of phosphoric acid that would have been liberated from the ammonium phosfate present in the propagating vat at this same interval. This was a second detail that was not taken care of in Dr. Free's experiments. Readings of the hydrogen ion concentration were taken after each of these additions. I then had added sulfuric acid in the same fashion that Dr. Free had it added ultimately in amounts corresponding to the amount which could have been liberated from the ammonium sulfate present in the propagating vat before the end of the sixth hour and again the hydrogen ion concentrations were measured as expressed in pH units. This gave me a table of acidities comparable to those that Dr.

Free obtained but decidedly more acid. While the original mash was of substantially the acidity that he found, the addition of lactic acid increased the acidity slightly, about 1/10 of a pH unit. The addition of the phosforic acid increased the acidity greatly, by over 1 pH unit and the final addition of 13.6 cubic centimeters of sulfuric acid which, using the acid of the strength that I employed, corresponded to the total amount of sulfuric acid that could be produced from the taken weight of ammonium sulfate, brought the pH acidity to 2.73, a very strong acidity, a very high hydrogen ion concentration. This experiment then so far without ammonium lactate was now repeated without variation except that the equivalent amount of ammonium lactate was added, that is, an amount equivalent to what would be present in defendant's feed up to the end of the sixth hour and similar readings were taken after each addition, as outlined above.

Very similar pH values were obtained but now significantly higher; that is to say, the acidities were significantly less. Thus at the end of the experiment after 13.6 cubic centimeters had been added of acid, the acidity had dropped only to 3.0, a difference of .27 pH units, showing the effectiveness of the ammonium lactate, the added ammonium lactate, in neutralizing the deleterious acidity that was present. The sheet of data from which I have explained also states the materials and amounts used.

(A copy is received in evidence and marked Exhibit P-21.)

Q. 435. In your testimony on prima facie, I think you also spoke of some tests which you had conducted, and some acidity figures from that test were given defendant's counsel at his request. How do the acidity figures and pH values in those runs compare in general with the figures that you have just explained on the more recent tests?

A. They are very similar; that is, I will point out that these measurements made by the addition of sulfuric acid to the wort give acidities substantially comparable to those experiments that I have referred to in which acidity was released by the growing yeast. The data on Plaintiff's Exhibit P-21 was data obtained in a wort where there was no yeast growing. And in the other tests, the yeast was in actual process of propagation.

Q. 438. Dr. Lamb, have you any materials in the court room by which you can give us a demonstration, a graphic demonstration, on the question of whether ammonium lactate acts as a neutralizer of sulfuric acid?

A. Well, I have prepared some dilute sulfuric acid, and I have also prepared a mixture of ammonium lactate and lactic acid, and I can with a little of that, I think, show visually the neutralizing effect of ammonium lactate on deleterious acidity. In this bottle I have some water containing sulfuric acid that is just about the concentration corresponding to pH3.4. One can demonstrate that by adding some of this indicator called bromo-phenol blue, which is a dyestuff, to this liquid, some has already been added, I can add a little more—this deep color disappears, and we have this same yellow color, not quite a clear color. These colors can be identified by making accurate measurements with an instrument to find the true pH, and color charts have been prepared in various handbooks, by means of which one can check up from the observed color as to the actual pH, and by a comparison under proper light conditions of this solution with such a color chart, either in a book or on a card, the hydrogen ion concentration expressed in pH units can be ascertained. This, then, is a decidedly acid solution from the point of view of yeast manufacture. It is down to a point where

acidity is significant and must be considered. I have here in this little flask a dilute solution——

MR. JOHNSON: Do you want to show the Court the chart there?

THE WITNESS: Would you be interested in seeing the chart? This is the color chart (handing to the Court).

A. (Continuing.) To make an accurate match one has to use white backgrounds and take a good many precautions that are not easy to take in a court room but I am only hoping to show this in a rough fashion. Now, this solution contains ammonium lactate and lactic acid that is, there is an excess of lactic acid, and this solution is acid although not so strongly acid as that. But this will show a very considerable titratable acidity; it is by no means neutral, it has a pH somewhere—I don't know exactly what it is but around 5. This is an acid solution then, which I will now proceed to add to another acid solution, only a stronger acid, and I want your Honor to observe the changes that occur. I will do it slowly. I only added a few drops but already the color has changed, losing the yellow and getting more to the blue. Now I think we will see, although I have only added a few drops of this liquid, I have switched that acid over from a pH of around 3.4 to a value which your Honor will see up here is somewhere around 4.2 or 4.3, up to an acidity that is no longer deleterious to yeast growth. This illustrates then in very simple fashion—it can be repeated by anyone that is interested—the neutralizing action of an acid solution of ammonium lactate on yeast-deleterious acidity. Lactic acid is in the little flask. Its titratable acidity is 4.0, which is exactly the titratable acidity used in the feed in defendant's operations.

Q. 443. Now, based on your study of the buffering experiments made by Dr. Free and these tests which

you yourself have conducted, which you have explained, do you agree with the final conclusion expressed by Dr. Free that in operations as conducted by defendant shown in its mash sheets, which are in evidence, 99 per cent. or more out of the possibly released acidity from the ammonium sulfate was remedied or prevented from becoming deleterious by the buffers in the molasses?

A. I do not.

Q. 444. From your experiments and the tests you have had made can you give us any figure or tell us now what conclusion you draw from Plaintiff's Exhibit 21 on that subject?

A. Plaintiff's Exhibit 21 shows that, whereas without ammonium lactate the addition of 8 cubic centimeters of acid brought the pH to 3.0, with ammonium lactate 13.6 cubic centimeters of the acid was required to produce the same effect. In other words, the presence of the ammonium lactate took care of 5.6 cubic centimeters or something like 40 per cent. of the total deleterious acidity over this range.

Q. 445. 5.6 cc. Have you had prepared a table listing the items of the prior art relied on by the defendant in this case and indicating data with respect to such items of the prior art on matters with which we have been concerned in the case so far?

A. Yes, I have a table prepared which you have there in which I have attempted to get in a small space the significant information with regard to the patents that have been discussed in this case.

Q. 446. On the table referred to in connection with the Polsky patent, under the third column, is the notation:

"No, because stated chemical composition of salts made no difference."

Please explain the reason for that notation, if you will? I will refer you particularly to page bearing the

number 3 in the Polsky patent, the British patent, in the second full paragraph on the page, beginning, "Half an hour after having added."

A. The only addition of inorganic salts that I find suggested or referred to in this patent occurs in the paragraph to which you have called my attention. In this paragraph at lines 14 and 15 the patent states—

"I add the same quantity of carbonate of ammonia $(NH_4)_2CO_3$, or of sal ammoniac (NH_4Cl)" and so forth. These two ammonium salts differ, however, significantly from the point of view of their utility in yeast manufacture. While both of them are sources of nitrogen, only one of them releases acidity which would be deleterious to the growth of the yeast; namely, the ammonium chloride or the sal ammoniac. The patentee, therefore, does not recognize the existence of any acidity problem connected with the use of these salts.

Q. 447. Please refer to the notation in the second column under the Jacquemin patent, which I will not read into the record, and refer to the Jacquemin patent, the British patent, at the top of page 3, which reads:

"The receiver A is a sterilizer supplied with all the necessary adjuncts, it can be cooled in any convenient manner, the molasses which I use for my process is placed in it (preferably at the lower part of the receiver) at about 28° Baumé, but any other fermentable sugared wort may be employed with the addition of other matters or ingredients useful for fermentation, as for example:—Maltopeptone, phosphate of ammonia, etc.: and which are submitted to a long sterilization by steam."

Do you understand the patentee to say in that paragraph that molasses may be used?

A. Yes.

And as an alternative to molasses he may use other fermentable sugar wort.

The British patent to Molhant refers to the seed yeast and a special procedure for acclimatizing it to high acidities.

Q. 450. Is that seed yeast thereafter to be employed in making alcohol or in making bakers' yeast?

A. In the manufacture of alcohol.

The Jacquemin patent which was referred to a moment ago speaks of a solution having a density of about 28 degrees Baumé. According to the table in Van Nostrand's Chemical Annual, 28 degrees Baumé corresponds to a solution containing 51 per cent. of sugar. In other words, roughly, to about 51 Balling.

Referring to the French patent to Roth, the table that I have referred to has the notation that this deals with a preparatory treatment only, as can be seen from examination of the summary in this patent contained at the end of the translation.

Q. 454. The notation on the table with reference to the Pollak patent in the final column states "preparatory treatment only." Is the disclosure of this patent also a pre-treatment before the material is used at all in yeast propagation?

A. Yes.

Q. 455. In the sixth column of the table with reference to the Henneberg articles is the notation "not clearly stated even in distilled water; clearly stated, none in ordinary water, commercially used" and in the second and fifth columns is the notation "experimental." Do you know whether this author, about that date, published a practical handbook?

A. Yes, he did publish such a handbook, which he utilized in connection with his teaching activities in the Brewing Institute in Berlin.

In that textbook there is a section devoted to the procedure of yeast manufacture with molasses.

THE WITNESS: In this section of Henneberg Praktikum of 1909 to which I refer, Section III, page 643 of

the original volume, and pages 6 and 7 of the translation, Henneberg gives a brief presentation of how yeast may be advantageously manufactured from molasses.

As regards the addition of nitrogen Henneberg states: "Nitrogen in the form of yeast extract or malt sprouts, for example, must be added to the molasses. An addition of phosphates (super-phosphate, ammonium phosphate) likewise proves to be expedient." This is the only reference to the nitrogenous nutriment contained in this article and there is no clear statement of the utility of ammonium salts, as such, as the source of nitrogen and none whatever of any utility in the neutralization of released acid from any such salt.

Q. 459. The next item on the table refers to the article by Brenner in the Centralblatt. The table has the notation that the article describes experimental work on molds and under the third column notation is made, "No, says acid harmful to molds and yeast practice used acid to prevent infection" and under the sixth column the notation is "No."

A. This author describes in this section to which reference has been made of a very long article, a number of experiments upon a particular mold, aspergillus niger, and these experiments are conducted on a small scale in small glass flasks, about 100 cubic centimeters only of solution being employed, and the author finds that acid is produced in the growth of these molds and points out that the resulting acid is harmful and indicates that lesser yields are obtained because of its presence. No yields, however, are actually given in these experimental measurements on the scale that is employed in commercial yeast manufacturing. Now, this fact that acid is developed, that is harmful to the molds, of course just confirmed what yeast-makers knew and recognized. They added acid to their propagating solutions because they were firmly convinced, they knew

by long and bitter experience that acidity was necessary to prevent the growth of these harmful molds and other harmful organisms that might flourish to the injury of the yeast. The yeast manufacturer from these experiments would then find his own opinion strengthened and instead of being led to neutralize this acidity would say, "So much the better, the less danger of infection will result."

MR. WATSON: I think the other items on the table are either self-explanatory or explanatory by counsel in view of the documents from which the excerpts are made. I will offer the table in evidence as Plaintiff's Exhibit 22.

(Received and marked Exhibit P-22.)

Q. 460. Have you had a similar table, under different headings of course but with respect to the Rainer, Iwanowski, Delbruck and Lafar articles which I understand are the only articles relied on by the defendant herein against the '105 patent and the regulated feed features of '106 and '109 and Corby '735.

A. Yes.

Q. 461. The first reference noted on this table under the Rainer patent under the third column bears the notation "No, preferred process adds all peptone at start and sugar (in constant amounts) at three-hour intervals, giving unbalanced feed."

"Unpreferred process adds sugar (in constant amount) at intervals giving unbalanced feed. In each process no sugar added until prior amount exhausted."

In your opinion does that correctly state the disclosure of the Rainer patent on those points?

A. Yes, it does.

Q. 462. I think we can make a little more haste if I ask you some questions at this time about testimony

given by Dr. Free regarding tests he had conducted along what he thought were lines of the Rainer patent. In his testimony, beginning at record page 285, he described two runs which he selected as typical of those conducted by him; one was at temperature, as I recall, approximately that stated in the Rainer patent, and the other at higher temperature. Have you reviewed Dr. Free's data of those runs?

A. Well, I have read them.

Sufficiently so that I know in general the materials he used and the procedure he followed.

Q. 464. In your opinion did those runs as conducted by Dr. Free depart in any material respects from the disclosure of the Rainer patent?

A. Yes, I think they did in several significant, material items.

Q. 465. The Rainer patent discloses the use of about ¼ per cent. of phosforic acid. Have you figured what per cent. of phosforic acid was used by Dr. Free?

A. I haven't the exact figures here but my recollection is it was about 0.27 per cent. of 85 per cent. phosforic acid in Dr. Free's experiment.

Q. 466. In the low temperature experiment Dr. Free had made additions of his molasses solutions of the propagating vat at three-hour intervals but his four additions were respectively 1.75 liters, 2 liters, 3 liters and 2 liters. Do you find any disclosure in the Rainer patent either in the third paragraph from the end of the specification which speaks of three-hour additions or elsewhere corresponding to the increasing amounts or increasing rate of addition as thus used by Dr. Free in his run?

A. I find no such teaching in the Rainer patent. In so far as additions are specified, they are at constant amounts, after the first addition, or in one alternative case at a constant feed.

I have calculated the amount of sugar in the respective additions used by Dr. Free on the basis of the entire wort, but I haven't those figures with me.

Q. 468. Please refer to the British Lake patent, a copy of which I hand you. I call your attention to the paragraph in the middle of page 5 beginning "When the entire amount." Dr. Rautenstrauch testified for the defendant that this paragraph made a disclosure of the addition of both sugar and peptone gradually and continuously. Do you find any such disclosure?

A. I think it is my recollection that Dr. Rautenstrauch had reference to the corresponding paragraph of the German patent in his testimony. Perhaps he might not have been willing to have made the same statement with regard to this paragraph.

Q. 469. Perhaps it was in your absence, but this particular paragraph was called to his attention and he testified as I have stated.

A. Well, I can see no justification in reading this paragraph for reading back into the preceding sentence the alternate possibility with regard to the feed of the peptone solution. It seems to me that any clear and unbiased reading of this paragraph would show that nothing is said as to the possibility of adding the sugar at a gradual and continuous rate.

Q. 470. Please refer to the translation of the German Rainer patent corresponding to the British Lake patent. I ask you whether you find any disclosure in the German of the gradual and continuous addition of both sugar and peptone to the wort?

A. I do not, although here, since the two clauses are not separated into separate sentences, the argument is less binding.

Q. 471. Dr. Free said that he used amounts of peptone and sugar in the fermenter to start in his repeated experiments of 10 and 1, which are his so-called Rainer experiments, a peptone and sugar ratio of 2 to 1, and he added sugar and peptone according to the figures

which are on the record, so that considering the total peptone and total sugar over the full-test period, the peptone and sugar ratio was 1 to 2; in other words, the ratio at the start was reversed during the progress of the test. Do you find in the Rainer patent any disclosure of the procedure followed by Dr. Free in this respect?

A. I do not, sir. This patent, which is quite confused in many respects, is clear and definite in all of its indications on the principle that the sugars shall be added at about only one-half the concentration of the peptones. That principle is adhered to throughout where any reference to amounts is made, and Dr. Free departed from this clear and unequivocal teaching of the patent in this respect to a marked degree.

Q. 472. Referring now to the high-temperature experiments which Dr. Free conducted and described on pages 295-6 of the record. Dr. Free said this experiment had another significant difference from the low-temperature experiment, besides the difference of temperature, namely, that he added molasses nutrient every hour instead of every third hour. Do you agree that this was a significant difference?

A. Yes, I do. By diminishing the period between the additions he approached more nearly to the ideal that the Hayduck patent discloses of a substantially regulated feed, adapted to the growth of the yeast.

Q. 474. In the high-temperature experiment Dr. Free's hourly additions of molasses solution were at an increasing rate or amount, the respective hourly additions being .25, .35, .45, .65, .75, .85, .95, 1. and 1. In your opinion does the Rainer patent make any disclosure of adding molasses or sugar except in a fixed and uniform amount at regular and uniform intervals?

A. Except that he does speak of a larger addition at the beginning, but thereafter only in fixed amounts at regular intervals.

Q. 475. What does the Rainer patent mean by saying "Same nutritive solution may remain in use for weeks and months"?

A. This is a statement which I have not been able to understand or to believe was indeed possible in commercial manufacture. There are two reasons why this could hardly be achieved. In the first place, the dangers from infection over long periods of time and particularly in the slow fermentations that Rainer adopted, and with the slightly acidified peptone wort that he employed, were great. This difficulty Dr. Free recognized.

Another difficulty, and one which is evident even to the casual reader, is that in vats of any given size, any actual vats, since the peptone at least is added in solution, and presumably also the sugar, water is constantly being added to the propagating vat, and all that is being taken out is the cream yeast.

Now it is quite out of the question to remove, by this means, water at the same rate as it would be introduced and under any ordinary conditions this vat would overflow in progress of the manufacture. This statement of the patent like the use of such practical additions as ozone and the sterilization of the air with potassium permanganate and phosphorus are features that indicate that the patent was a product of the study rather than the factory.

Q. 476. Is there any published treatise of recognized authority which refers to the process of the Rainer patent, do you know?

A. Well, there is the well-known Kiby Handbook of Yeast Manufacture. This book is entitled "Handbuch der Presshefen-fabrikation," Handbook of Manufacture of Pressed Yeast, and has a statement at the bottom of page 6 relative to the Rainer patent. The book is dated 1912; lines 8 to 5 from the bottom of the

page are as follows—I can translate that or I think we have a prepared translation.

Translating it, "Dr. Rainer in Vienna obtained in 1879 a patent for the manufacture of compressed yeast without the production of alcohol; much peptone and a little sugar were brought to fermentation; nevertheless the process did not come to a successful realization. All the large scale experiments to that end were uniformly unsuccessful."

(A copy of the British Patent 778 to Lake received in evidence and marked Exhibit P-23.)

Q. 481. Referring to the second table again as to the Delbruck item, under the third column and under the second column, the notation in each case is "No." Dr. Rautenstrauch testified with respect to the Delbruck article that there was a disclosure of taking some concentrated wort and highly diluting it and then feeding in the more concentrated reserve. Dr. Rautenstrauch based this testimony on Delbruck's statement that he could start "with but little wort." Do you find the Delbruck disclosure there or elsewhere shows the use of highly diluted wort?

A. No, there is absolutely nothing stated as to the dilution of this wort and a study of the process as there described shows that such wort was not diluted. In general, it was the ordinary wort fed in to the vat and fermentation started and the remainder of the solution fed into this solution with rapidity, depending on the yeast manufacturer's schedule, in a few hours or more as required. That is an alcohol process. The Lafar article also made disclosure relating to alcohol production.

The theoretical yield of alcohol in sugar, according to the usual chemical equations that are written, is somewhat over 50 per cent. by weight. I think amounts of alcohol in sugar by fermentation slightly under 50 per cent. can be secured.

Q. 486. What is a typical figure for the sugar equivalent of corn, if you know?

A. Those figures too I haven't exactly in my head, but I know they are in the region of 55 to 60 per cent. on weight of grain. A similar figure for the sugar equivalent of malt is just about the same.

The Delbruck article refers near the end of the second paragraph under section 10, to a continuous fermentation process. That refers to a process of continuous fermentation that was used particularly in distilleries or plants manufacturing alcohol for distillery purposes where, instead of making separate additions of yeast, the yeast was propagated in solutions and then the solutions containing the yeast were fed in a systematic fashion into a series of vats to which original nutrient solution was also added, and enough vats taken so that the process could be operated in a continuous fashion. The fermentation of one vat would be completed after three or four days, so that the vat could be emptied and the process continued in that empty vat. So that it was a process continuous in the sense that the same yeast is utilized continuously.

Delbruck wrote a well-known book called "Brennerei Lexikon"; I think that it was in 1915, but I don't remember exactly. I would have to see the book to be categorical about it, but it was very nearly that date. He did not in that book make any disclosure of a regulated feed of concentrated reserve into a dilute in yeast manufacture as far as I know. He described commercial yeast manufacturing practices which were then being used or had been known, in an article beginning on page 347.

CROSS-EXAMINATION BY MR. PHLEBIN:

XQ. 493. In connection with your discussion of the '105 Hayduck patent you referred to solutions of 3 degrees and 5 degrees Balling as having been known

before the date of that patent. Can you tell us what kind of worts those solutions were used in? Perhaps your recollection may be refreshed, Doctor, if I read your words found on page 358 of the testimony: "3 to 5 is not a dilute solution, a particularly dilute or highly dilute solution or wort. Solutions of 5 degrees were not unusual in the date preceding this patent in the commercial manufacture of yeast." I am asking you what worts you were referring to.

A. I was referring in that particular instance, I am sure, to the manufacture of yeast by the aeration process as of a date preceding the date of the patent. That would be in 1914 and earlier. That is what I meant.

Considerable variety of materials was employed in these worts which I spoke of, which had these concentrations of 3 to 5. I know that grain worts were employed of that concentration and no doubt molasses or mixed molasses worts of similar density were employed. I consider that concentrations of from 3 to 5 degrees Balling were normal prior to 1915. Three degrees to five degrees concentration in terms of Balling normal certainly would include normal concentrations prior to 1915; how frequently the lower concentrations were employed I don't know, but 4 to 5 was certainly a frequent concentration employed.

XQ. 499. The Hayduck '105 patent states that there is placed in the fermenting vat a solution which is 1 degree Balling and that thereafter there is added a solution of 12 degrees Balling. If you commence with a solution of 1 degree Balling and you thereafter add 12 degrees Balling, is not the average of the entire amount found to be somewhere between 1 degree Balling and 12 degrees Balling?

A. Might I ask whether you are referring to the addition with consequent yeast multiplication, or in the absence of yeast multiplication?

XQ. 500. With yeast multiplication or without. The question, Doctor, was simply this: If you start with a dilute solution of 1 degree Balling and then you add 12 degrees Balling, would not the average be bound to be somewhere between 1 and 12?

A. Your question has no sense, as I get it. The average of what, Mr. Philbin?

XQ. 501. Of the amount that you have used, of the 1 degree Balling and of the 12 degrees Balling.

A. If you want the average of what is introduced over the whole period, without considering yeast growth at all, the average value would obviously, without any yeast multiplication, be less than 12 and more than 1.

XQ. 502. Yes. That is, the average would be somewhere between 1 and 12, if you added those two together and took an average?

A. But the average there used is a figure which represents the arithmetical mean between 1, the weight of material originally in the converter or propagating vat, and 12, the weight of material added.

XQ. 503. And that would be between 1 and 12, wouldn't it?

A. The weight of material added is, of course, 12 times the total volume; if you understand that. The weight of material in there is 1 times the total volume. The total material added then on that basis would be 13; and if you wish to know what the average would be, it would be, of course, 6½ in that sense, if you are going to add the same volume. If you are going to fill up the fermenter in each case separately, once with 1 degree Balling and again you are going to fill it up with 12 degrees Balling, then the average between those two numbers would be 6½. But that obviously couldn't be done. That is a physical impossibility, isn't it?

XQ. 504. Now, if you agree with me, as apparently you do, that if you take 1 degree Balling and 12 degrees

Balling, that the average, when you add them together, would be somewhere between 1 and 12, and if you had exactly the same amounts, as you say, it would be 6½, then if you add more in the beginning of 1 degree than you do of the 12 degrees, your average will be lower than 6½, will it not?

A. Surely. You can so choose the amount of the dilute wort that you can obtain the mean value of 3 to 5 in this fermenter.

XQ. 505. And will you not always obtain this mean value of from 3 to 5 if you put in substantially more dilute solution or use substantially more dilute solution than you do the concentrated solution?

A. I can answer that if you will give me just a moment; there is a little arithmetic required. No, you will not come inside of the rule on that basis, necessarily.

XQ. 507. Suppose you have twice as much in your dilute solution, taking 1 degree Balling, for example, as you have in your 12 degree solution; will you come within this 3 to 5 range?

MR. JOHNSON: You mean twice as much total volume or twice as much of the concentrated wort?

MR. PHILBIN: I mean twice as much of the dilute wort at 1 degree in gallons as you would have of the concentrated 12 degree Balling in gallons.

A. Yes, if you start with concentrated solution of 12 degrees Balling; if you start with a more concentrated solution you would not. It all depends on the Balling of the concentrated wort.

XQ. 508. If you start with a Balling of 16 degrees would you come within this rule,—and by start I mean using a concentrated Balling of 16 degrees to be used first by diluting a part of it and then by feeding the remainder?

A. No, you would not.

XQ. 509. Is there any teaching in the patent that a 16 degree Balling is outside the desirable range?

A. No, it is not outside. A 16 degree Balling can be utilized as a nutrient solution, as a concentrated nutrient solution.

XQ. 510. If it is used does it come within this 3 to 5?

A. It can be used and it will come when volumes are properly taken,—it will come nicely within this rule. That is the beauty of the rule, it will fit any concentration of the concentrated wort; it can all be adjusted by this very simple calculation.

THE COURT: Just one moment, please. To what page do I turn for the experiment we had here on the 3 to 5 Balling?

MR. WATSON: 619.

By THE COURT:

Q. 511. In considering the experiment or demonstration given by Dr. Lamb, demonstrating the meaning of the words in the specification of '105, lines 90 to 95, I am still in doubt as to what meaning is placed upon the word "employed" as used on line 94. For the purpose of clearing up my doubt on that point, I will ask, Dr. Lamb, the question: According to the teaching of the specification a wort is prepared having a gravity of 12 degrees Balling and I have before me a book which we will say is the tank in which that 12 degree Balling is kept. As I understand it, a portion is taken from the 12 degree Balling tank and diluted down to 1 per cent. Balling and the tank containing the 1 per cent. Balling is book No. 2, and into that tank is planted the seed yeast; thereafter the concentrated wort from the 12 degree tank is fed to the yeast in the 1 degree tank at a rate which the specification prescribes. Then the

specification provides as follows: "The quantity of the diluted wort which is originally available for the yeast is so chosen, for example, that the mean content of the entire wort employed would be 3° to 5° Balling."

Now, in the experiment, as I remember it, we were considering a quantity of wort left over in the 12 degree tank and mixing that with the quantity left over after harvest had been taken of yeast from the 1 degree receptacle and these two tanks then being mixed produced a 3 degree to 5 degree Balling. Is that correct?

A. No, sir.

Q. 512. Well, what is wrong with that, Doctor?

A. May I stand up?

Q. 513. Yes.

A. Because I can see your books better.

This rule and all my discussion of it and all my experiments to illustrate it has to do with the solutions before any yeast is grown whatever. After the yeast has been grown, of course——

THE COURT: Now, just read that answer to me, please, because I think right there is where my difficulty is.

A. (Answer repeated by the reporter.) After the yeast has been grown, most of the food has been used up.

Q. 514. Now, that leads me right back to the word "employed." So that experiment that you gave us had nothing to do with the wort employed in the growth of the yeast?

A. No, sir; in that sense, the solution which I prepared was what would have been obtained if the two worts spoken of in the patent had been combined at the start, before any yeast growth had occurred. They would have made a third wort, which was never prepared by the yeast manufacturer; he didn't need to do that, he could make this computation in his head; but

that is what would have been obtained. That third wort would have had a density of 3 to 5 degrees Balling.

Q. 515. Well, don't you think when you read this, or do you understand when you read this portion of the specification to which I have just referred, that the inventor is talking about a wort that has been employed?

A. No, sir, he is not.

Q. 516. In producing yeast?

A. No, sir, he is talking about a wort the constituents of which will be employed for the manufacture of yeast.

Q. 517. But he doesn't say that, does he?

A. Yes——

Q. 518. He says "employed."

A. There is the word "would" in there.

Q. 519. "That the mean content of the entire wort employed."

A. Yes.

Q. 520. Now, that means to my mind used?

A. Ultimately——

Q. 521. Now that means used.

A. Yes.

Q. 521a. And after it has been used, it produces the 3 to 5 degree Balling?

A. No,——

Q. 522. That is my difficulty, to see it any other way.

A. But your Honor seems to think that after it has been used it would be 1 degree Balling. All of us agree——

Q. 523. Well, whether you do or not, I am concerned with the words of this disclosure here.

A. Yes. May I point out that all of that solution actually is employed in the making of yeast, not as the solution, but the two constituent parts are all employed in that tank for the making of yeast. It is all the wort that is employed; the entire wort that is employed in

that tank for making yeast would have a 3 to 5 degree Balling if it were mixed together at the start. That is exactly what it says, and all the——

Q. 524-5. Now, let me see. If it were mixed together at the start?

A. Yes.

Q. 526. You start with 12 degrees?

A. Yes.

Q. 527. You dilute it to 1 degree?

A. You take a part of it, such as you need, and dilute it——

Q. 528. Now, you tell me that that makes 3 to 5 degrees.

A. If you take the right volume of this concentrated wort and put it in your fermenter, and dilute with a proper quantity of water, you will obtain a solution which, when mixed with all the wort that you are going to add later, so that you will then have the entire wort employed, you will get 3 to 5 Balling.

Now, I can tell your Honor a way of looking at this that will, I think, short-circuit all your difficulties as to volume. Another way of stating this simple rule would be to say that it is advisable to have in the fermenter 3 to 5 per cent. dry raw materials based on the total content of the fermenter. That is all the sentence says when interpreted in the language that any yeast man, practical yeast man, would understand. Suppose we had a fermenter that would hold 100,000 pounds. All this rule says is that you must take of sugar and molasses or grain, or whatever dry material you have, that will dissolve—you must take between 3 to 5 per cent. of that solid material in that fermenter, which would be——

Q. 529. But the teaching is you take one?

A. No, the teaching is you take between 3 and 5 per cent. for the entire wort. You take a 1 per cent. for the dilute and a certain amount of the concentrated.

But this statement to which I refer can be paraphrased by saying you should take for the best propagation of yeast by this process 3000 to 5000 pounds of yeast nutrient material for a hundred thousand pound fermenter, and it doesn't make any difference what the concentration happens to be of your concentrated wort.

That is a simple way and I think perhaps would have given you less difficulty, but the two statements are exactly equivalent and the reason for that second statement, of course, is clear.

Q. 530. As I gather from the language we read here in the specification, the teaching is you can grow this yeast in a 1 degree Balling solution at the start and that you feed from the 12 degree reserve in such a way as to maintain an average of between 3 to 5 degree Balling in the fermenting vat. Now, it is difficult for me to get the thought at all other than as I have just stated it, because then it seems to me that if I take the view that was given in the experiment it is an arbitrary thing and not within the language of the specification, and that's where the trouble was here.

A. Well, of course, if you assume that the patentee wishes you to maintain an average Balling of 3 to 5 degrees——

Q. 531. Now, the reason I say that, Doctor, is because it is clearly stated in the patent itself that the 3 to 5 degree Balling solution is that solution which is employed. Now, it wouldn't be employed until it was used as the fertile ground upon which the yeast grows. It is so employed in that sense and it is the only sense, as I see it at the moment, in which we can give meaning here to that word.

A. I cannot see it, your Honor—I mean I am sorry to disagree, but I know that "would be" implies what is actually the case, that that is the Balling of what the solution would be if the dilute wort and the concentrated wort were mixed all at one——

Q. 532. (Interrupting.) You see, Doctor, that you added water to the 1 degree and the 12 degree in such proportions as to bring it out 3 to 5 degrees Balling. You just added water here. Now, there is not anything here that tells us to add water except up to a 1 per cent. solution.

A. That's all I added; I added no water except to a 1 per cent. solution.

Q. 533. And then you kept dripping in out of the 12 to get it to around between 3 and 5, and then you must have had a lot left over because you couldn't have gotten it from 3 degrees to 5 degrees Balling without having some of that reserve left over, could you?

A. I don't know if I had any left over or not. That is a big reserve tank; it doesn't make any difference——

Q. 534. The size of the receptacle doesn't mean a thing?

A. No, the rule will hold with any size receptacle.

Q. 535. Therefore, getting back to the word "employed" if you put the meaning I put on it it means you wouldn't be justified in measuring any of the 12 degree Balling which had not been used in the manufacture of the yeast?

A. It is ultimately used, every bit of that 3 to 5 Balling material is used in the manufacture of yeast, is employed in the manufacture of yeast. This is just a device for telling you how much of that dilute solution to take in a given fermenter.

THE COURT: Proceed, gentlemen.

By MR. PHILBIN:

XQ. 536. Turning to the '105 patent on page 1, line 70, it states: "A part of this wort is placed in the fermenting vat and is highly diluted (for example, to about 1° Balling), yeast is added thereto and it is aer-

ated." Do you find any statement in the patent that any yeast is grown in that 1 degree Balling? If so, please point it out.

A. As far as I know, it does not specifically state it. Of course, it doesn't need to state it, it is self-evident.

XQ. 537. But the patent itself merely states you have this 1 degree Balling, and thereafter you add yeast, and thereafter you aerate, and thereafter you add the 12 degree Balling, and thereafter the mean content of the entire wort employed is from 3 degrees to 5 degrees Balling?

A. I see no "thereafter" in the sentence referred to; "yeast is added thereto and it is aerated."

XQ. 538. Don't you think that the fair reading of that, Doctor, is that you have this dilute solution and that you add yeast to it and then you aerate?

A. Of course, that is just what you do do, and yeast instantly begins to grow as any yeast manufacturer knows.

XQ. 539. That is the seeding operation, is it not?

A. The adding of the yeast is the seeding operation. The patent has pointed out the favorable nature of a dilute solution for the growth of yeast in the preceding lines.

XQ. 540. Is there any statement in the patent that after this seeding operation there is yeast propagated in the 1 per cent. solution?

A. That is the natural teaching of the patent, yes.

XQ. 541. Can you quote any words which so say?

A. Yes, the discussion of the Rainer patent clearly brings out that fact, points out that the Rainer patent utilized a high dilution for the propagation of yeast. Hayduck further points out that a use of this very low concentration of sugar entails certain difficulties in operation; then goes on to say he accomplishes the purpose here without these attendant difficulties of opera-

tion. He, of course, implies that he is utilizing these dilute solutions in the same way.

XQ. 542. Do you mean that Rainer taught the use of dilution of the order of 1 degree Balling? Is it upon that basis that you say that Hayduck was growing yeast in 1 degree Balling?

A. Rainer taught the use of relatively dilute media, perhaps always not 1 degree but they may have approximated to that as attenuation progressed. Many of the claims of Hayduck '105 are clear, indicating this same interpretation. They speak of initiating propagation of yeast in a diluted portion of said wort. That means that the propagation actually begins to initiate.

XQ. 543. You say many of the claims. Will you tell us which one is representative of this view of yours?

A. The second claim speaks of initiating propagation of yeast in the diluted portion of said wort; the third has the same phrase; the fourth the same; the fifth the same.

XQ. 544. Does the claim say what Hayduck considered to be dilute was 1 degree instead of 3 to 5 degrees as contrasted with the 12 degrees that he also mentions?

A. Yes, the lines that we have discussed a good deal speak of the dilute wort originally in the fermenter as highly diluted, and that is referred to in the claims in these phrases that I have spoken of as diluted and in one of the claims at least it says "highly diluted." So that it is entirely clear from these claims that the growth of yeast is initiated in this highly diluted solution originally in the fermenter. I refer particularly to claim 10.

By The Court:

Q. 545. Well, there is one word here I think too that perhaps adds to the thought that it is intended

that the yeast will grow. If you will look at line 83 you will find the word "assimilated." Isn't it obvious that if yeast assimilates it carries with it the idea of growth?

A. Yes.

Q. 546. It feeds, it grows?

A. Yes, that is true.

Q. 547. So we have it right in that paragraph that we are concerning ourselves with, the intent, read in connection with the fact that this is a yeast process we are dealing with and then reading that word "assimilated" the intent is undoubtedly, as I see it, at the moment, there, to have the idea of growth.

MR. PHILBIN: Yes, yo .r Honor, that is after the thicker wort has been added.

THE COURT: Yes.

By MR. PHILBIN:

XQ. 548. Taking the examples given in the Hayduck patent of 12 degrees Balling of an average of from 3 to 5 and an initial concentration of 1 degree Balling, how much more of the dilute solution originally in the fermenter in gallons would there be than the amount of the added concentrated wort?

A. There would be something over 6000 gallons difference between the two figures.

XQ. 549. Well, would you not have four and a half times as much dilute solution as you do the added solution, if your average is 3 degrees, and would you not have as to the dilute solution, if your average is 5 degrees, 1.75 as much of the dilute solution as you do of the higher 12 degree solution?

A. Well, I have checked your first figure on the basis of 3. You will have something over four times as much dilute solution originally in the fermenter as you will add. I can check the other figure, if you wish.

XQ. 550. Is it not exactly 4.5?

(At this point a short recess was taken.)

XQ. 551. Are you in a position to answer the question, Doctor?

A. What is the question?

(XQ. 550 repeated as follows: "Is it not exactly 4.5?")—

with an average of 3, and 1,75 with an average of 5?

A. It is very nearly that. I, just doing it hastily, have 1.8 and 4.4.

XQ. 552. Then if the amount of dilute wort that is put in the fermenter is either 1.75 times as much as the wort that is added from the 12 degrees during propagation, or if the wort that is initially in the fermenter is as much as four and one-half times as much as the added wort, it would be within this rule, as you understand it?

A. Only when you select a 12 degree concentrated wort. With the other worts the volume would be different that would be required. The rule takes care of that, however.

XQ. 553. I am assuming the specific figures given by Hayduck 12 degree Balling and dilute wort of 1 degree Balling and an average of 3 degrees to 5 degrees.

A. With those specific figures that is true; with other figures, other volumes would be required.

XQ. 554. So that if you commence your process with a dilute wort that ranges anywhere from 1.75 to 4½ times the amount that you add you would be within this rule?

A. Yes, your mean content of the hypothetical solution would be within this rule; you would have added between the 3 and 5 per cent. of foodstuffs to this vat, which is all that the patentee wants you to do so as to get not too much yeast and not too little; if you get too little you are not realizing the full economy of your

process; if you add too much you will overcrowd the yeast at the end. If you take about 3 to 5 per cent. by weight of the total contents of the fermenter you will get into no trouble and that is just another way of stating this rule.

The amount of raw materials that are used by the yeast depends upon the amount of seed yeast that is being used—not critically but over wide ranges it is affected by the amount of seed yeast.

XQ. 556. Substantially?

A. Yes, if you didn't add any you wouldn't get any yeast.

The Hayduck patent does not state anything with respect to the amount of seed yeast that should be used.

The Hayduck '105 patent, lines 66 to 70, states, with respect to the kinds of materials that should be used, "A wort adapted for yeast propagation (having, for example, a gravity of 12° Balling) is prepared according to the procedure commonly followed in the compressed yeast industry."

XQ. 559. Is there any other reference to what the procedure was that was commonly followed in the compressed yeast industry except the reference to the Rainer patent which used sugar and peptone?

A. Yes, there is in addition to this statement a statement on page 2, lines 30 to 37, which reads as follows: "and it therefore—referring to the Rainer process—lacks the simple operation characterizing the process herein described, which does not differ in any way, in regard to the production of the wort and the amount of labor required, from the usual procedure followed in the manufacture of aerated yeast."

XQ. 560. My question was: Is there any description in this Hayduck '105 patent of the kinds of materials which may be used other than the description of Rainer's process which used peptones and sugars?

A. If you are searching for some statement as to definite raw materials, I don't think there is any such statement.

There is no statement as to the proportions of the materials to be employed, that is, how much sugar material in comparison with nitrogen material, except in those general statements which would cover the questions that you raised, which I have already mentioned.

With respect to this 3 to 5 so-called principle, that does not have anything to do with the rate of feeding the nutrient solution into the fermenting vat.

XQ. 563. Now, what rate of feeding does this Hayduck patent teach should be followed? That is, should the feed be constant or should it be intermittent or should it be so much one hour, so much the next hour?

A. Well, it gives the general statement to which I think I have already referred repeatedly in my testimony at an earlier session of the court; for instance, the lines at the top of the right-hand column, first page, the first paragraph in fact, which I think it is hardly necessary to quote again, it has been read in so many times.

XQ. 564. Does this patent say anything more about the rate of feed other than that it should be a good rate of feed, namely, one that did not produce too much alcohol and one that gave the proper nourishment to the yeast?

A. I do not think that your statement is quite a fair one of the direction. The direction to furnish suitable quantities so that the yeast would have the optimum concentration of food for its growth is something more than just a general direction that you could characterize as good. Of course, to a yeast manufacturer it at once becomes evident that this optimum condition of the right concentration could be regulated and controlled simply by observations of the density of the

liquid, the nutrient liquid during yeast propagation. This is a procedure which every yeast manufacturer is familiar with and which he would immediately adopt in order to secure this goal, this optimum condition, to which Hayduck calls attention. It is my view that the yeast-makers of 1914 would know those things.

XQ. 566. So that when Hayduck says you should feed the yeast with concentrated wort at such a rate that the yeast would grow well and there wouldn't be too much alcohol, your view is that the yeast-maker would know by testing and experiment what the different rates should be?

A. He could tell by his Balling readings what the proper rate was, and he could soon tell from his yields and from the production or non-production of serious amounts of alcohol as to whether he had really achieved this end that Hayduck had pointed out to him.

XQ. 567. Would it be a matter of experiment and testing on the part of the yeast-maker to find out what was the rate of feed which would give the desired result?

A. He might have to do it more than once to get the very best results from the process, but the very first time he ought to be able to do much better than he ever did before.

XQ. 568. This patent says that you should feed the yeast so that no large excess of alcohol would be formed and the yeast could assimilate most of the alcohol which was so formed. How would the yeast manufacturer know whether or not the rate of feeding was such that little alcohol was formed, or that such alcohol as was formed was being eaten by the yeast?

A. He could tell, as I have indicated, by the yields which he was able to secure. Relatively small production of alcohol corresponds to a considerable loss of yeast. This would give him an indication as to the

success of his operations. If he wished to do it in a highly scientific fashion, which I think would hardly be necessary, I am sure it would not be necessary, he could make tests on his solution for alcohol that was present.

XQ. 569. How would he know whether alcohol was being formed or not if he merely tested the amount of yields of yeast?

A. Well, if he obtained anticipated yields, excellent yields, he would know that no great quantity of alcohol could have been produced.

XQ. 570. What would be the anticipated yields? Is there anything in the patent about anticipated yields?

A. They are spoken of as high yields as contrasted with previous yields, in the first three lines previously referred to on page 1, second column. I don't find any definite statement of percentage yield in this patent.

I do not find any statement in this patent that the yields would be higher than those of other processes.

XQ. 572. So how would the manufacturer, taking this Hayduck '105 patent which merely says you have a high yeast yield with this regulated feeding process just as the same patent says that Rainer obtained the high yeast yield, how would the manufacturer know by testing his amount of yield whether or not he was obeying the instructions of the patent?

A. He couldn't utilize any exact figures, that is perfectly true, for forming an estimate on this score, but he would know what was a high yield, based on operations outside of this patent, which were common prior to it, and this would give him some idea. I have told you that this indication was not a quantitative one, but it would furnish him with some information as to whether or not any considerable quantity of alcohol had been formed.

XQ. 573. How would it, Doctor, if you got the same yields as were obtained by other processes?

A. I haven't said that he got the same yield that is obtained by other processes; I am confident he has gotten very much greater yields.

XQ. 574. Does the patentee say that he obtained greater yields than were obtained with other processes?

A. The implication is that he does obtain higher yields than are obtained unless one uses a highly diluted solution.

XQ. 575-6. Doctor, I am trying to find out what this patent teaches to the manufacturer. As to what rate of feeding should be employed. You first say that the manufacturer will know the proper rate because he would get an increased yield. You also say there is nothing in the patent which says how much the yield should be except that it is a high yeast yield, and there is also in the patent that Rainer obtained a high yield. So I do not see how the manufacturer would know because he obtained a high yeast yield, which was old, that he was doing the feeding at the rate which the patent provided.

A. The high yeast yield which, by your logic, might have been obtained by Rainer was obtained in the absence of alcohol. If this patentee secures that same high yield he too can conclude that he has no alcohol present in his solution. If, as he does, and which was a matter of fact is the case, secure a higher yield than was obtained by manufacturers of yeast at that period, working in more concentrated solutions, and should he secure a good deal of alcohol, he can again conclude that he obtained no alcohol or negligible amounts of it in his solution.

The test is not whether or not alcohol is obtained or formed.

That is just one of the features that are pointed out. The other feature was he kept track of the density of his solution so that he knew he wasn't feeding too

fast for the assimilation of the sugar. I don't see any others now.

The boiling point of alcohol is 78, approximately, Centigrade. That of water is 100 degrees Centigrade.

XQ. 583. Do you know in worts, such as those we have been considering, about what is the evaporation of water in a wort, for example, containing 10,000 gallons?

A. I don't know, I am sure; it depends on the humidity of the day very largely. Suppose it is a very humid day, it would be relatively small. I should say that it would vary between a few per cent. and perhaps 10 per cent.

If there is any substantial amount of alcohol in the water, alcohol will also evaporate with the water to some extent.

XQ. 587. That is, not all the alcohol will evaporate, just as not all the water will evaporate?

A. Depending on the temperature, the concentration of the alcohol, and the time of aeration and the volume; the fraction may vary from an infinitesimal one to several per cent., perhaps, of the whole.

XQ. 588. You gave your conclusions as to the assimilation of alcohol which might be formed by the yeast, according to the testimony of Mr. Luce. Did those conclusions relate to the processes as illustrated by Defendant's Exhibit D-9 (a), etc., D-9 (g) being illustrative, being laboratory No. 2671, dated September 14, 1925? You may recall, Doctor, that, according to my copy of the typewritten testimony on page 391, you testified on direct examination as follows: "Did you hear the testimony of Mr. Luce regarding the alcohol tests on plaintiff's commercial Zulauf processes and on the comparative blank test containing similar small amounts of alcohol without yeast being present?

"A. Yes.

"Q. What are your conclusions as to the assimilation of such alcohol as might be formed by the yeast during such processes?

"A. My conclusion from those experiments as I heard them recounted, is that the yeast did assimilate substantially all of the alcohol that was formed." My question is, were those conclusions based upon Defendant's Exhibit D-9 as explained by Mr. Luce?

A. Yes. These seem to be experiments with regard to which Mr. Luce testified at the point you refer to and upon which my conclusions as so expressed are based, at least in part. It was my understanding that during the operations shown in Defendant's Exhibit D-9 (g), laboratory experiment 2671 of September 14, 1925, there was a substantial amount of sugar in the wort, fermentable sugar. It is my recollection that Mr. Luce said this was a regular commercial run, and I can't tell you how much.

XQ. 595. Doesn't the amount of sugar present affect strongly, if not in a controlling manner, the production of alcohol?

A. The presence of sugar in excess of that required for growth promotes alcoholic fermentation.

XQ. 596. If you do not know how much sugar there was present in this wort, how can you tell whether or not alcohol was formed?

A. In the commercial operation of these processes it is my understanding that an adequate amount of sugar in the feed is run in to obtain a rapid growth of the yeast, and that that entails the presence in the solution of a small amount of fermentable sugar continuously.

XQ. 598. How much? One per cent., 5 per cent., a half of one per cent.?

A. I shouldn't like to say how much, but I should say a significant amount.

I should think that a tenth of a per cent. would be a significant amount. Whether a tenth of one per cent. is a normal amount of sugar to be used in the commercial manufacture of yeast would depend on the moment at which you removed it and so forth, because the yeast is eating the sugar rapidly, but I should certainly consider that one-tenth of a per cent. was a significant amount.

In this process as shown in Defendant's Exhibit D-9 (g) at the start there is shown a Balling after filtration of 1.05. That indicates that there is dissolved solids present in this solution of approximately 1 degree Balling. In that same column underneath that figure of 1 degree Balling there are other figures of Balling. They are all above 1 degree Balling; they run from 1,02, as the lowest, to 1.75 as the largest.

XQ. 604. Would you understand from that that in that process there was a sugar content from about 1 degree Balling to about 1.7 Balling?

A. There are dissolved solids of that amount; it isn't pure sugar, but approximately so. This would represent approximately the sugar. The higher figures at the end are doubtless due to an accumulation of other solid materials in the solution. The portion of the Balling at the very start is to be ascribed to this same effect. So that I don't wish to be too precise in my statements as to the amount of sugar.

In that report of that process there is also shown the figure with respect to the presence of alcohol of two-tenths of one per cent., at the first and second hour on the basis of proof spirit. I think that is equal to one-tenth of one per cent. by weight of alcohol.

XQ. 608. Does that report show that there was present in this solution about 1 per cent. of sugar or more and that there was never more than 1/10 of 1 per cent. of alcohol?

A. The figures do not show any higher figure for alcohol than two-tenths proof spirit, which as you say would be approximately one-tenth on the basis of absolute alcohol or weight of alcohol.

I consider that in a wort such as shown in that exhibit in which there was ten times as much sugar as alcohol, some consumption of alcohol would take place, small to be sure, as compared with the consumption of sugar but not so small when compared with the actual percentage of alcohol present in the solution. I should say that yeast prefers sugar to alcohol when both are available. I am sure it does.

I know the treatise of Guillermond on "The Yeasts" which was translated in 1920. It is a recognized textbook.

XQ. 613. Would you agree with this statement: "Generally alcohol is not assimilated by yeasts and it is then useless to them?"

MR. JOHNSON: Pardon me, will you give the witness the full title of that book, Mr. Philbin? Have you the full title of it?

MR. PHILBIN: The title is "The Yeasts," by Guillermond, translated by F. W. Tanner in 1920. I believe Dr. Lamb said he was familiar with it.

THE COURT: We will take a recess until Thursday morning.

(Recess.)

MR. JOHNSON: If your Honor please, there was a question day before yesterday to Dr. Lamb about the date of publication of Delbruck, "Illustriertes Brennerei-Lexikon," and it was stipulated between counsel in the first Federal suit that that book was probably published in 1914, and was available in the New York Public Library prior to

March 15, 1915. I think that is the fact, although Mr. Philbin was not a party to that stipulation originally.

MR. PHILBIN: I do not know what the fact is, your Honor, but if counsel state that as their understanding to be the fact, I am willing to accept it for the purpose of this case.

MR. JOHNSON: That stipulation was entered into because the book bears the date of 1915, and Mr. Howson wanted it plain on his first record that it was prior to March 15, which is the first date of the Hayduck application in Germany.

CROSS-EXAMINATION BY MR. PHILBIN (Continued):

XQ. 614. Dr. Lamb, I understand that the following is in the book Guillermond "The Yeasts" as translated by F. W. Tanner in 1920, page 100: "The yeasts are able to withstand strong doses of alcohol, sufficient to kill organisms. They are able to live in a medium which contains from 10 to 18 per cent. of alcohol while other organisms are killed by from 4 to 10 per cent. Generally, alcohol is not assimilated by yeasts and it is then useless to them." I am handing you a copy of that book which was just given to me by plaintiff's counsel.

A. I agree in part with this statement. In explanation of my answer, I would say that by the term "yeasts" the author may well cover a great variety of yeasts, not merely bakers' yeast which is under consideration here, but wild yeast and related organisms. I would also like to point out that the concentrations of alcohol discussed here are very high, quite outside the range of what we have been discussing in connection with this question here, and I would say that I am not in agreement with the concluding sentence, "Generally, alcohol is not assimilated by yeasts and it is then use-

less to them," if that is made absolutely rigid. I would say that under many conditions that is true, but if one understands "generally" as "frequently" I would agree with this statement. I would point out in this connection that in this very same book on page 78, in speaking of the physiology of yeasts and their assimilation of hydrocarbon compounds, the author points out that yeasts can utilize alcohol as a source of carbon. Specifically, on the next to the last line on page 78 the author states: "Lindner and Cziser, reference (5) found alcohol a source of carbon, and the reference (5) is to Lindner and Cziser and the title of the article is "Alcohol a More or Less Excellent Nutrient Medium for Different Organisms," Wochenschrift fur Brauerei 29, pages 1 to 6. Then it gives also a reference to "Chemical Abstracts," Volume 6, page 1916, of the year 1912.

I have read that book since I was asked a question about it last Friday, but I had read this previously a while ago because very similar questions were asked in the early litigation, almost the identical questions.

XQ. 617. Do you find any statement in that book that yeast will consume alcohol when there is available to the yeast fermentable sugar?

A. There is nothing to the contrary. That sentence that I just read is so interpretable.

MR. PHILBIN: Will you ask that question again, please?

(XQ. 617 repeated by the reporter.)

XQ. 618. Will you answer that question, Doctor?

A. I did answer it, I think. Will you read the answer?

MR. PHILBIN: Read the answer.

A. (Answer to XQ. 617 repeated by the reporter as follows: "There is nothing to the contrary. That

sentence that I just read is so interpretable.") The sentence that I read does not say that sugar was also present, or alcohol and sugar was also present, but it doesn't say that it was not present; and, as a matter of fact, I know that work to which reference is made by Lindner, perhaps not in this particular article but in other articles, did have sugar present when yeast assimilated sugar—alcohol, I should say.

XQ. 619. Doctor, that seems to me like a very simple question. Do you find anything in this Guillermond book which says that yeast will eat alcohol in the presence of sugar? You say you found nothing to the contrary; I am asking you whether you found a positive statement to that effect.

A. No. I don't think there is a positive statement to that effect.

XQ. 620. As I understand it, you are inclined to disagree with the statement in Guillermond: "Generally alcohol is not assimilated by yeasts and is then useless to them"?

A. I disagree with it in the way that I pointed out, but I agree with it when you interpret "generally" in the sense of "frequently."

I referred to some experiments by Lindner and Cziser. I have not studied those experiments.

XQ. 623. Do you know whether or not any sugar was present in those experiments?

A. I think there was sugar present in either those experiments by Lindner, or other experiments about the same date, made by Lindner.

XQ. 624. I am talking about the experiments which are referred to by Guillermond, experiments by Lindner.

A. Well, I said that I have not read this specific reference lately, but I do know that work by Lindner at approximately this date utilized sugar and alcohol,

and I think we have somewhere an extract from such an article.

The article by Lindner and Cziser, "Alcohol a more or less excellent nutrient medium for different organisms," in the Wochenschrift fur Brauerei 29 1-6, "Chemical Abstract" 6, 1912 (1916) is the one I referred to in my answer to your question, and in reading the textbook.

XQ. 626. Are you prepared to say that in those experiments in which alcohol was found to be a good food for yeast, there was any sugar in that solution?

A. I am not prepared to say that in this particular one there was, because I can't be sure, but in work at the same period by Lindner there was.

XQ. 627. But that work is not referred to in this Guillermond book at the point that you refer to?

A. I can't say whether it is or not. I just referred to this article and told you that I was not sure that it was in this particular publication of Lindner that this particular statement occurs.

XQ. 628. I understood, Doctor, that you quoted this statement: "Alcohol a more or less excellent nutrient medium for different organisms," as appearing in this Lindner and Cziser article as a basis for your theory that yeast will eat alcohol in the presence of sugar, and I now understand you to say that you don't know whether or not there is any sugar present in the experiment recited in that article, is that correct?

A. No, you haven't recapitulated my statement correctly. I, from the very start, have said the same thing, that in work by Lindner as of this period there is a reference to the use of alcohol and sugar simultaneously in which the alcohol was assimilated by the yeast. That is a restatement of what I said at the very outset.

THE WITNESS: I ask to have brought into the court a reprint of an article in "Chemiker Zei-

tung," referring to Lindner's work, which I would like to read in this connection, since you insist on a definite statement.

XQ. 629. I am not insisting on anything, Doctor. You quoted this Lindner article as supporting your position, this particular specific Lindner article, and I asked you whether that specific Lindner article did describe the experiments in which there was sugar.

A. You continually misquote me. When I first referred to it I said I was not sure that it was this particular article, and I have reiterated that repeatedly.

XQ. 630. Now, will you refer to any article which you may have found which says that yeast will eat alcohol in the presence of sugar?

A. I refer to page 299 in the "Journal of the Institute of Brewing," Volume 34, 1928, to the statement: "Provided oxygen is present, the alcohol is assimilated by yeast more readily than sugar of equal concentration. If both are present the alcohol is taken up first by the yeast." And that refers to work by Lindner. This, however, was not the reference that I had in mind when I answered first.

XQ. 631. Referring now to the Hayduck '105 patent, does that speak of a concentrated wort of 12 degrees Balling and worts of from 3 to 5 Balling and a wort of 1 degree Balling?

A. He speaks of a wort of 12 degrees Balling; he speaks of another wort prepared from this by dilution that will have a Balling of 1 degree, and then he says that hypothetically if a mixture of the concentrated and the dilute were taken in suitable proportions the mean Balling of this hypothetical wort would be 3 to 5 degrees Balling, but there is no mention of a concrete wort of 3 to 5 degrees Balling.

XQ. 632. Does the patent speak of different Ballings, of 12 degrees, of 3 to 5 degrees and of 1 degree?

A. It speaks of those Ballings, yes.

XQ. 633. Is the 3 to 5 degree Balling more dilute than the 12 and the 1 degree more dilute than the 3 to 5?

A. The hypothetical solution to which you refer, the hypothetical wort which is not actually utilized, which is not actually made—it is stated that that would have a mean Balling of 3 to 5.

XQ. 634. I am sorry that I did not make myself clear, Doctor. I merely asked you if the 3 to 5 Balling was more dilute than 12 and if 1 degree was more dilute than 3 to 5.

A. If you state that as a question divorced from the patent, why, I am willing to say that, of course, because those figures are quite as you say.

XQ. 635. You referred yesterday with respect to this question of dilution to claim 10 of the Hayduck Patent '105, which speaks of "initiating propagation of yeast in a highly diluted portion of said wort." Do you understand that this "highly diluted" portion is the 1 degree Balling or the 3 to 5 degrees Balling?

A. No, sir; it has to be the 1 degree because there is no 3 to 5 degree Balling wort.

XQ. 636. Now, in claim 4 I find the statement, "initiating propagation of yeast in a diluted portion of said wort." Do you understand that the "diluted portion" refers to the 1 degree or to the 3 to 5 degrees?

A. It refers to the 1 degree.

XQ. 637. So that you consider the expression "highly diluted" to mean exactly the same as "diluted"?

A. No, it doesn't mean exactly the same as claim 10, which is to emphasize the dilution limitation of the claims. "Highly diluted" means somewhat more diluted than diluted.

XQ. 638. Don't you think that a fair reading of those words is that when the patent refers to "highly diluted portion" it means something different from when it refers to "a diluted portion"?

A. A slight difference, of course, but it has already defined highly diluted and diluted as about 1 degree Balling and "highly diluted" would be on the more dilute side.

XQ. 639. Isn't 3 degrees—5 degrees more diluted than 12 degrees?

A. Three to 5 is a more dilute solution than a 12 degree Balling solution.

XQ. 640. Isn't it a perfectly reasonable interpretation that a wort of higher concentration is added and the propagation is started with a diluted portion, that the diluted portion refers to 3 and 5 degrees?

A. No, I don't think that is reasonable at all. There is a faint verbal possibility merely. The words can be stretched to that interpretation but in so doing you go against the plain teachings of the patent.

XQ. 641. The claims of the patent speak of a wort of higher concentration and of a wort of lower concentration that is more dilute. Is there any limit in the patent as to what is more concentrated and what is less concentrated?

A. Do you mean by that if there is any upper limit set to what the concentrated solution could be?

XQ. 642. Yes, or any low limit or any ratio between them.

A. I would have to answer that individually, first as to the concentrated solution. The wording of the specification in the paragraph beginning on line 66 is such as to indicate that the concentrated solution is taken of such a gravity as would be usual or such as would be according to the procedure commonly followed by the compressed yeast industry. That would

set a reasonable upper limit, not in figures but to common knowledge of the skilled operator at the time.

Now, as regards the 1 degree Balling, the lower limit, I don't think that even there there is a fixed limit set. The patent specifically says to about 1 degree Balling. Now, one could work at a lower degree and special situations might make it particularly desirable to go below 1 degree, but of course if you go too far below, as the patentee points out, you run into extremely dilute solutions and cumbersome sized propagating vats. So that while there is no fixed limitation, common sense and the knowledge of the art at the time would serve to guide one adequately.

XQ. 643. You said that the skilled workers in the art at this time would know what the higher limit might be. What would that higher limit be, do you know?

A. Well, I think that one wouldn't care to use undiluted molasses, for instance, if that were the source of the wort because there would be great difficulties in its proper purification and preparation for use; it would be cumbersome to handle. I don't want to give any definite figures because I think that they don't mean much, but certainly you could go a good deal higher than 12 degree worts; grain worts and molasses worts up to 30 degrees were used as of this date in the art by other various processes of yeast manufacture, or at least they had been used, and so one can go up quite a little above 12 degrees, but 12 degrees, I should think, was a convenient and usual Balling for the concentrated wort.

XQ. 644. You said that the patent pointed out that if you had too dilute a solution you would have to use large vats. Will you point out where the patent says that?

A. It is discussing dilution in connection with the Rainer patent at the bottom of the first column, page

1. It says: "However, the increase in operating costs connected with this high dilution is partly compensated for by the advantage of the high yield in the yeast." That is, it points out incidentally there the disadvantages of high dilution.

XQ. 646. You referred to this "high dilution" disclosed by Rainer and referred to in this Hayduck patent. What was that dilution as you understand it?

A. Well, as I have said, the Rainer patent is vague in many respects and quite confused, but it does speak of the use as the limiting concentration of 2 per cent. of peptones. We have approximately half that quantity of sugar which would make 3 per cent. Now, that is the maximum figure given. Most of the figures are considerably less than that. So that I think a fair statement would be that the concentration of the solutions as disclosed in the Rainer patent would be in the vicinity of 1 degree Balling.

XQ. 647. This Hayduck '105 patent speaks of a rate of feed "such that the yeast may propagate and substantially all of the alcohol which may be formed is assimilated by the yeast," referring to the final clause in Claim 4. What does the patent say as to what that rate should be; that is, whether the rate should be continuously increasing, whether it should be about the same, whether it should be decreasing, whether it should increase during one part of the process and decrease during another?

A. The patent says at the bottom of page 1, lines 99 and thereafter, "the yeast is constantly given new supplies of all nutrient constituents necessary for its propagation by the continuous addition of concentrated wort, and that thereby as a result of the continual consumption of the nutrients by the yeast, there is always a wort concentration, by means of which the nutrients and the resultant substances are absorbed most efficaciously and quickly by the yeast, that is to say, there

is offered in this manner of procedure through the peculiar distribution of the wort, the advantage of great dilution, while the concentration of the wort (calculated for the entire quantity) remains normal." That is, that phrase makes it clear that the nutrient solution is supplied at a rate such that the yeast can eat up that nutrient material with maximum rapidity, and that the food doesn't accumulate in excess, lead to other disadvantageous results, nor is it present in a deficit, so that the yeast cannot eat as fast as it otherwise would. And that is a very good statement as to what is to be obtained, and how the feed is to be varied.

XQ. 648. Doctor, I agree that that is a clear statement as to what should be "a result of the continual consumption of the nutrients by the yeast." I am asking you how is that result to be obtained, by what particular rate of feeding.

A. Well, I have already in a good many answers to your questions, told you how one can utilize the measurements of the density as a guide in this respect. I have also pointed out how one can interpret from the total amounts of yeast produced whether a suitable rate has been achieved. I could add to that, which I didn't happen to think of before, that it was part of the knowledge of the operator of that time, that yeast, as it is propagated, increases in amount, and, of course, will have to be given increased portions, increased amounts of nutrient. So that if this admonition of the patent is to be followed, the yeast maker will give continuously increasing amounts of foodstuffs to his yeasts. If he is interested he can, of course, harvest portions of his yeast from time to time and find out how much he has got there, and that will give him an added indication as to how much foodstuffs he must supply.

Broadly speaking the rate should increase during the earlier portions of the run until somewhere near the amount of yeast is secured that is desired. Thereafter I think it may or may not decrease.

XQ. 651. Is there anything in the patent which says that the rate should increase in the beginning and perhaps not increase thereafter?

A. Well, of course, it is quite a self-evident inference, and self-evident conclusion, that if you are going to stop your propagation, you have got to stop feeding some time; you can either stop off with a bang, or you can stop somewhat more gradually at the end, depending in part on the condition that the yeast maker wishes to have his yeast in at the end.

XQ. 652. And you consider, do you, that the yeast maker at this time knew at what rate the feed could be used to accomplish this result?

A. I think that, given the teachings of the Hayduck patent, the yeast maker knew enough to apply them successfully.

XQ. 653. In 1915?

A. Why, certainly.

XQ. 654. By that do you mean, I want to be sure I understand you, that you consider that the yeast maker in 1915 could read this '105 patent and that he then knew enough, because of his other knowledge, what particular rate of feed he could use, to accomplish the result stated in the patent?

Mr. Johnson: You appreciate, of course, Mr. Philbin, that these patents were not issued until 1919 in Germany. You are assuming that the patents came out in what years?

Mr. Philbin: I am not assuming anything. I am asking you whether Dr. Lamb is of the opinion, as I understood he already stated, that in 1915

the yeast maker knew how to employ a rate of feed so as to accomplish the desired result.

Mr. Johnson: I think the witness specifically stated after a review of Hayduck's disclosure, if he had known what Hayduck said.

A. That is all I would care to modify my statement. I assumed that the yeast manufacturer had the Hayduck specification and claims before him; but knowing the teachings of the Hayduck patent as of that date, I am confident that he could obtain the desired results.

XQ. 656. Your assumption was correct, that I meant to include in the question that the yeast maker in 1915 had the Hayduck disclosure before him.

A. I don't quarrel as to the exact year, because I don't know, but as of about that date, certainly.

By The Court:

Q. 657. Doctor, referring to Patent '105, and commencing in line 66, which reads: "A wort adapted for yeast propagation (having, for example, a gravity of 12 degrees Balling) is prepared according to the procedure commonly followed in the compressed yeast industry." What is meant by the procedure commonly followed at that time in the compressed yeast industry?

A. Well, the procedure that was commonly used in the factories where compressed yeast was made. That procedure would vary, of course, with the raw materials utilized in the particular factory, but it involved the preparation of a solution that would be favorable to yeast growth, that contained either sugar itself or saccharified sugar.

Q. 658. What degree Balling would that be at that time?

A. It would vary in different factories, working on different——

Q. 659. And vary between what points?

A. Some factories might draw off a concentrated wort from their materials of 20 degrees, 30 degrees Balling. Usually it would be—they draw off worts of, I should say, 8 degrees or 10 degrees always. You see, it is the wort drawn off from the raw materials, the solid materials, used as nutrients, either the saccharified grain or the molasses.

Q. 660. You see, the inventor here refers to 12 degrees as an example.

A. By way of example.

Q. 661. What was the practice at that time, was that 12 degrees practiced at that time?

A. I think that one cannot say that 12 degrees or 15 degrees was practiced. It is a matter of very little significance.

Q. 662-3. He says "prepared according to the procedure commonly followed" and what I am concerned with I want to know whether 12 degrees Balling was the nutrient in which they grew the yeast at that time. Did they plant the yeast in 12 degrees Balling nutrient at that time?

A. In some factories they did, in many factories that operated under what was called the newer "Aeration Process," they used worts as low as 3 and 5 degrees Balling for the propagation.

Q. 664. At that time?

A. That was known at that time.

MR. WATSON: If the Court please, I think when the patent says "is prepared according to the procedure commonly followed" it refers to the mashing operations rather than to the particular Balling there.

THE COURT: Yes, I think likely that would be a fair reading of it, but I was concerned with the question of whether or not the 12 degree solution was used at that time as a nutrient in which to grow yeast.

MR. WATSON: It was not unknown.

THE COURT: In other words, the improvement is in growing the yeast not in a high solution but growing it in a dilute solution, and it must be below 12 because he starts with 12. That is the real disclosure, isn't it?

MR. WATSON: Growing in the 1 degree or the highly dilute but getting the advantage of that growth in that high dilution and the advantage of handling his reserve material in the more concentrated form.

Q. 665. Then it is a mere matter of convenience, isn't it, that 12 degree solution?

A. Absolutely. That 12 degrees just happened to be——

Q. 666. It is the reserve on the side?

A. That's what he happened to have in his tank.

THE COURT: The same as the hay in the barn, as the cow uses it to produce milk.

By MR. PHILBIN:

XQ. 667. In your testimony you said (Tr. 350), referring to the Hayduck '105 patent, "The inventor had tried this process out." Do you know whether or not Hayduck was a yeast manufacturer?

A. I don't know whether Hayduck was engaged in the commercial manufacture of yeast, but I do know that he was connected with an institute that investigated yeast manufacture and that he carried on tests of yeast manufacture on semi-works scale, possibly on full scale, very likely, at the Brewing Institute, but I cannot of my own knowledge say that that is the case; but that is my understanding.

XQ. 668-9. He was professor at the research laboratory, was he not?

A. They called it the Brewing Institute. They took young men from the brewing industry and the yeast-making industry and trained them to make yeast in this institute, and I think that was his chief occupation, was the teaching of these young men how to manufacture yeast.

I have never met Professor Hayduck.

When I made the statement "The inventor had tried this process out," I think I must confess that I had no factual basis for it; I ought to have said "doubtless tried this out."

XQ. 672. Does the Hayduck '105 patent teach that the addition of the nutrient material should be continuous or that it should be replaced at intervals as consumed?

A. Of course, the whole patent must be construed in with the general teaching of the patent before one that the foodstuffs are to be fed to the yeast at a rate such that a proper food supply is given. Now, this can most conveniently and perhaps best be secured by a continuous addition at a regulated rate because we are growing large quantities of yeast and the development of the yeast is a gradual and continuous process, but obviously if it were interrupted momentarily you still could achieve the goal that you are after. It seems to me that the thing has been brought out by the statement in the claims that substantially——

XQ. 673. Doctor, I just wanted to get the answer to the question.

A. That it is substantially continuous.

XQ. 674. Does the '105 patent teach that the addition of the nutrient material should be continuous or that it should be replaced at intervals as consumed or both or neither?

MR. WATSON: I have refrained from objecting to several of these questions, if the Court please,

because I don't want to interfere with the cross-examination. At the same time I don't want defendant's counsel to ask questions which are in the province of the Court and scope of the claims. Now, in the former litigation, for instance, in the Federal suit, Judge Soper has held the patent to cover one of the things that Mr. Philbin is asking the witness and I don't want to have the witness answer from a fact point of view and then have it susceptible of misinterpretation from a legal point of view.

MR. PHILBIN: I was not asking the witness with respect to the claims; I was asking him, or at least I meant to ask him and I now ask him whether in the description of the patent there is described a continuous addition of this nutrient material or an addition by intervals or both a continuous addition and an addition by intervals.

MR. JOHNSON: Pardon me, Mr. Philbin. Your last question asked whether it is continuous or at intervals. Your preceding question asked whether it was added continuously or was replaced at intervals. Now do you mean the same thing or something different?

MR. PHILBIN: I mean the same thing.

THE COURT: Well, you refer, I suppose, to the language in the specifications about line 75.

MR. PHILBIN: Yes, your Honor; also at line 99.

THE COURT: That says, "added slowly and substantially continuously throughout a protracted period of time."

MR. PHILBIN: Yes.

THE COURT: So that is what that says. How could there be any question about what that means?

MR. PHILBIN: I do not think there is any question, your Honor, and I am asking whether there is also in the patent a statement that the feed may be added at intervals.

THE COURT: Well, what line do you say that is, 95?

MR. PHILBIN: I do not find that, your Honor, but I am asking the witness whether he finds any statement that the nutrient materials can be added at intervals. There is the statement that it can be added continuously.

THE COURT: Quite a latitude there in what is meant by "added slowly and substantially continuously."

MR. PHILBIN: Yes.

A. That is really all I want to bring out. I attempted to imply that when one says "substantially continuously" you must interpret that in view of the function that you are attempting to perform. If, for instance, the feed were put in at 10 second intervals, why, it would be substantially continuously and still in portions.

By MR. PHILBIN:

XQ. 675. Half an hour intervals?

A. I cannot give any fixed figure. I don't think I ought to tie myself to a fixed figure; it will all depend on the yeast requirements and the problems of manufacture and the physiology of the yeast, etc., whether it would stand half hour intervals or not.

XQ. 676. Might be hour intervals?

A. I don't know.

XQ. 677. Under some conditions?

A. I don't know; I don't wish to give any definite figures.

MR. WATSON: If Mr. Philbin has any special process of which he has the full data, perhaps he could ask the witness.

MR. PHILBIN: The witness apparently doesn't know.

MR. WATSON: The witness says, as I understood him, that it depends upon the process in other respects as well as that one.

XQ. 679. Do you know whether or not there is any particular virtue in continuously feeding the yeast nutrients as against feeding the yeast nutrients at intervals as required?

A. It seems to me, Mr. Philbin, you have asked a circular question. I have said that the materials are added as required. Now, if you can add them in portions as required with the same exactness that you could continuously, of course self-evidently it makes no difference, but broadly speaking, the teachings are that you will hope to achieve the advantages of Hayduck's process better by a continuous feed. You perhaps will sacrifice somewhat by going to an interrupted feed. Now, how much you sacrifice will depend upon how greatly you interrupt the feed, that is, how long the intervals. The injury that you do by departing from the patent is a matter of degree; that is it, of course. The further you depart from the patent the more injury you will suffer.

XQ. 681. Referring now to defendant's worts, you stated in answer to a question (Tr. 152), XQ. 280: "What is the average pH value in defendant's wort, approximately?

"A. Well, I don't carry those figures in my head and I don't think it is advantageous for me to try and remember," etc., and you said, "I think that we can supply you with those figures." And I said, "Yes, I would be glad to have them." Have you those figures

now as to the approximate pH values of defendant's wort?

A. I think so. I thought that you had been given copies of them. They were certainly prepared. It is my recollection that a typewritten copy of those pH values had been prepared, but I don't seem to have it. I have, however, a statement in words, which I can read.

XQ. 682. Will you just give the figures, Doctor, of the range of acidity in defendant's worts in pH units?

A. In the straight set experiments——

XQ. 683. I am not referring to experiments, Doctor; I am referring to the defendant's worts such as are shown in Plaintiff's Exhibits P-13, P-14 and P-15.

A. Well, I have, of course, the laboratory notebook, that has all the records on them.

XQ. 684. If you can give the initial acidity in pH units, and two or three intermediate values and the final values.

A. The initial pH values in the two checked runs were respectively 4.6 and 4.6. These were using for seed yeast Fleischmann Yeast; and then in two other checked runs, using National Grain Yeast, the initial pH readings were 4.5 and 4.5 respectively. At the sixth hour, the pH, with Fleischmann Yeast, had dropped to 3.15, in one instance, and to about 3.2 in the other instance. The readings were not precisely at the sixth hour in the second case, but they were substantially the same. Using National Grain Yeast—I have no reading at the sixth hour, but at the fourth hour it was 3.25 pH. Using Fleischmann Yeast at the ninth hour the pH was 3.45; at the eleventh hour 3.9. Using National Grain Yeast, the pH at the tenth hour in one run was 3.4, and at the eleventh hour in the checked run 3.65. The final recorded pH values were not determined with the Quin-hydrone Electrode but

with indicators, and at the fifteenth hour, with Fleischmann Yeast, were 4.4 and 4.5 respectively, and with National Grain Yeast 4.5 and 4.5 respectively.

XQ. 686. What is the lowest acidity that you found in these worts, which you made up in accordance with your ideas of defendant's wort? That is, the highest pH value?

MR. JOHNSON: That is, with ammonium lactate in the feed?

MR. PHILBIN: I had understood the witness was talking about the defendant's normal wort.

A. With Fleischmann Yeast, the highest pH and the lowest acidity was the initial acidity, 4.6 and 4.6 respectively. That was after seeding.

With the National Grain Yeast, the highest pH was 4.5 in each of the runs.

The lowest pH is 3.15, in the case of Fleischmann Yeast, and 3.25 in the case of National Grain. We have one or two readings with indicators—no, I thought we had a reading of an indicator low, but I find that we haven't, and I find there is a 3.1 reading with National Grain Yeast. So those are the lowest pHs or the highest acidities.

These experiments were made in January, 1935. We made four runs. That does not mean we made four different worts. We made them all on the same wort, so far as the composition of raw materials was concerned, the grain and molasses materials. The molasses was the commercial beet molasses, such as was used in large quantity by the Fleischmann Company. The range of acidity that I obtained was from 3.15 to 4.6.

XQ. 695. Do you know whether or not in defendant's commercial manufacture its worts go as high in acidity (low in pH) as 3.15?

MR. WATSON: In the earlier stage of the case, plaintiff addressed interrogatories to the defendant to bring out the acidities of defendant's processes as actually conducted. The answer stated that the pH readings had not been taken more than occasionally, and no information was forthcoming on the point. It was stated that the acidity was kept—well, this I will quote from the answer on the record at this point: "The degree of acidity is and was maintained below the point of absolute toxicity. The acidity was measured by any of the well-known methods and with a knowledge of the degree or point of toxicity dependent upon the kind of acid used or released from an ammonium compound during the fermentation. The degree of toxicity varies hourly depending upon the culture and the kinds of acid, and the concentration of the wort because the more concentrated the wort the greater the buffering action.

In the absence of more definite statement on defendant's part at that time, of course, we were handicapped somewhat and the testimony just given by the witness is in reference to some tests he conducted to simulate the defendant's operations. Now, if Mr. Philbin has any actual data of the pH in these runs of defendant, then he has some information which defendant has previously denied it possessed and which we asked for. If he has any information, I think the questions will have to be limited to the figures Dr. Lamb obtained.

MR. PHILBIN: I am asking Dr. Lamb whether he knows.

A. I do not know from any observations made in your defendant's plant. What I do know is based on my own experiments.

MR. PHILBIN: The interrogatories, your Honor, asked as to what——

THE COURT: Of course, I haven't read them.

MR. PHILBIN: No, your Honor—asked as to what was the acidity in defendant's worts, which were complained of, that is, those which were used prior to the beginning of the suit. The answer was that as to those worts the acidity was measured almost entirely by this so-called titratable acidity method and not by this pH method, and that was true so far as I know. We have been talking about this pH hydrogen ion method. Dr. Lamb has put in evidence some figures of a wort which he says was made up in accordance with mash sheet 177, of which figures are given in hydrogen ions or pH units. I am merely asking him whether he knows what those pH values were in defendant's wort. We have since the time that suit was brought made several determinations more as a regular practice of the pH values in worts similar to those complained of, and we do know as to those which were later than the suit what the general value was. There is nothing particularly critical about the values within 3 or 4 per cent. on the pH unit.

XQ. 696. Do you know, Doctor, whether yeast can be grown on a commercially satisfactory basis with worts of from between 3.5 and 5.5 pH?

MR. WATSON: What is the purpose of that question, Mr. Philbin? I mean has it anything to do with the issues?

MR. PHILBIN: I think so; I am asking if he knows.

(Question repeated by the reporter.)

MR. WATSON: You asked if he knows. I didn't fully understand the question but I think perhaps it would be better if you can specify the process in more detail and give the hours you refer to.

XQ. 697. Such as shown in the mash sheet M-177, part of Plaintiff's Exhibit 14.

MR. JOHNSON: Of course, your Honor understands that that pH is not shown on that exhibit.

THE COURT: Yes, I understand that.

(Question repeated by the reporter.)

MR. WATSON: The yields of those processes I think are already in the record.

A. The pH values were 3.5 to what?

XQ. 698. 5.5.

MR. JOHNSON: Mr. Philbin, may I ask at what periods they are 3.5 and 5.5 in your question?

MR. PHILBIN: Any.

MR. JOHNSON: You mean they may start out with 3.5 and be at that all the way through the process?

MR. PHILBIN: That is correct—question withdrawn.

THE WITNESS: I gave a lower limit of 3.15. I found afterwards 3.1 as one entry. That is more acid than 3.5.

XQ. 701. So that if you could grow yeast satisfactorily with the higher acidity of 3.1 you could also grow it at the lower acidity of 3.5?

A. Well, 3.1 was the low figure reached and for a relatively short period. I wouldn't care to say that you could grow yeast satisfactorily at that pH throughout.

XQ. 702. What pH would you consider satisfactory? About 3.4 or 3.5?

A. Well, it will depend on circumstances. It is very hard to make a categorical statement on acidities that will be subject to precise interpretation; but I think that if the pH value doesn't get any lower than 3.1 for a short while or 3.5 perhaps for a longer while, that commercial yeast production could be secured.

XQ. 703. Now, you also spoke of a figure at the other end, namely, 4.6, which means that it is not so acid, 7, as I understand it, being absolute neutrality, and 6 being a little acid, 5 being more acid, and 4 being still more acid. Do you consider that a solution with an acidity, a slight acidity, of about 5 pH would be undesirable?

A. Well, as one gets into the less acid solutions, the danger of infection becomes great, and while again I think the figures have to be taken broadly rather than precisely, I should say that you are approaching the point of where there is perhaps too little acid.

XQ. 704. But that would depend upon the particular materials you use and how they were handled, and other factors which enter into the commercial production?

A. Well, the pHs, of course, as I have pointed out, and as I think you will realize from the data that I have given you, vary in the course of a propagation. It is desirable to have the pH not too low, particularly at the end and the finishing up stage of the yeast growth. So that is another reason why precise values can't be given.

We used the hydrant water in this wort we made up according to our understanding of the mash sheet M-177—the pipe water in the laboratory from the mains.

XQ. 706. Do you know how much fermentable sugar there is in defendant's wort during the propagation?

THE COURT: Would that be shown by the Balling?

MR. PHILBIN: It would be indicated by the Balling and also by the amount of raw materials in the form of molasses.

MR. JOHNSON: Do you mean total materials or the content at any given time?

MR. PHILBIN: Both.

A. Yes. We took the figures that were furnished us in the interrogatory, and have made calculations as to the amount of sugar material present.

XQ. 707. How much was present during the first ten hours in Mash Sheet 177?

A. The figure I have is based on the entire period of the operation, so I can't tell you without some little calculation, but I can make that calculation if you will give me a a little time.

XQ. 709. In defendant's process as shown in this Mash Sheet M-177, was the fermentable sugar fed in until about two hours before the end?

A. It was fed in until 12:30—until 2 o'clock—which was, I think, two hours and a half before the end, if we consider the point where the separation started as the end.

The total period was 16½ hours up to the separation. Readings were discontinued on the Balling, and temperature, at the sixteenth hour.

We can't tell exactly how much water is evaporated from the fermenter in defendant's process during the propagation, because, of course, we don't know the humidity on the date in question. There doubtless was some evaporation.

I have measured the amount of the evaporation in the commercial manufacture of yeast in such operations as those here referred to. The amount all depends, as I have said, on conditions, but it is a few per cent.

A. I don't think it goes as high as that. No, I should say, 5, 6 or 7 per cent., something like that.

XQ. 715. Now, you referred to some tests made by Dr. Free with respect to alcohol and you stated (Tr. 422) referring particularly to Dr. Free's experiments 14 and 15: "Dr. Free concluded from this, as I recall his testimony, that during this period (from the 8th hour to the 10th hour) alcohol was indeed consumed by the yeast, but during this period no addition of sugar was made to the fermenter." Was this the testimony of Dr. Free to which you referred and which is found on page 282 of the record on cross-examination:

> "Now you can answer my question, if you will as to whether in your opinion yeast during propagation over this interval, after the feed has been stopped, may assimilate small quantities of alcohol, possibly formed up until that time?
>
> "A. That is my opinion, yes, sir; if it happens in the defendant's process that after the cessation of feed of sugar the sugar remaining in the solution is exhausted, then in my opinion it is possible that the yeast would absorb and assimilate some of the alcohol which had previously been produced and was still present in the solution."

If not, will you point out where Dr. Free made this conclusion as you quoted?

Mr. Watson: I call your attention, Dr. Lamb, to the question and answer on page 283:

> "XQ. 146. Can you express an opinion as to the operations such as shown by the mash sheets Exhibits 13, 14 and 15, as to whether or not yeast may assimilate alcohol during the period after the feed has terminated?

"A. Qualifying my opinion by the statement that I am, of course, not testifying as a practical yeast operator, it is my opinion that the sugar would tend to be exhausted during that period subsequent to the stoppage of feed and that if it were exhausted the yeast would tend to consume any alcohol present in the solution."

XQ. 715. (Continuing.) Having in mind that in both cases Dr. Free said if the sugar were consumed, then the yeast would eat the alcohol.

MR. WATSON: Lest there be any misunderstanding, we should also bear in mind Dr. Free's expressed opinion that the sugar would indeed tend to be exhausted during the period.

A. I think my answer is yes to that question.

XQ. 716. That was the basis for your statement?

A. Well, that certainly was part of it. I don't like to say that it wasn't something else but that was part of it, certainly.

MR. WATSON: I note on the record also Dr. Free's statement on 284 of the record, referring to this experiment that Mr. Philbin has inquired of: "and I am quite willing to state that in these experiments I believe that the yeast did use the alcohol during the two last hours of the experiment. At that time the sugar was actually exhausted in these particular experiments."

XQ. 717. And that statement of Dr. Free, is it not true, was not in connection with Experiments 15 and 16 but was as stated on page 283 in connection with Experiments 5 and 6?

MR. WATSON: I think you are right, Mr. Philbin.

XQ. 718. You stated, Dr. Lamb, on page 423 that you thought that Dr. Free had arrived at an erroneous conclusion with respect to the amount of alcohol that

was evaporated during the process, and you said: "It is possible on the basis of certain and sure principles of physical chemistry to compute the maximum amount of alcohol that could have been blown out by the quantities of air which he employed and they are considerably less than the amounts that his experiments indicated."

Have you made such a computation?

A. Yes, I made that computation before I made the statement, naturally, and I don't remember the exact figures but I found that the maximum amount of loss of alcohol from a tenth per cent. solution of alcohol at 30 degrees was about 8 or 10 per cent.

The principles I spoke of was Raoult's Law. In simple language that law tells what the vapor pressure of a volatile substance over a solution of that substance in some other volatile substance,—what it will be in terms of molecular concentration. If we know, in other words, the vapor pressure of pure alcohol, as we do, at 30 degrees, and if we know the molecular weights of water and of alcohol, which we do, it is a simple computation to find out what vapor pressure of alcohol will prevail in a saturated air blown through that liquid and knowing the volume of air that is blown through the liquid we can get a maximum value for the possible amount of alcohol that could be blown out and the maximum value that we could get, using the rates of blow which Dr. Free states is, as I have said, between 8 and 10 per cent., as I remember. Now, of course, actually it is less than that because one does not obtain true saturation blowing air through at such a rapid rate.

XQ. 721. Have you here any record of those experiments?

A. Those calculations, you mean? Yes, I have made notes——

(Recess.)

CROSS-EXAMINATION BY MR. PHILBIN (Continued):

THE WITNESS: Referring to the "Journal of the Institute of Brewing," 1928, and the reference on page 299 to a recent communication by Lindner in the "Wochenschrift Brauerei," I have read that communication.

XQ. 723. Did it relate to the growing of yeast in commercial manufacture, or did it relate to the experiments made with the yeast after it had been grown?

A. It referred to neither of those alternatives. It referred to the growing of yeast on a laboratory scale as distinguished from commercial manufacture, or at least that is my recollection; I don't know whether the author was definitely excluding commercial manufacture or not. But I don't think he specifically mentioned commercial manufacture, but he spoke of the growth of yeast.

XQ. 724. Do you understand that if Lindner made the statements which he is reported to have made in this communication, namely that provided oxygen is present, the alcohol is assimilated by yeast more readily than sugar of equal concentration, if both are present the alcohol is taken up first by the yeast, that he was referring to yeast in a propagating vat, such as is employed in the commercial manufacture of yeast?

A. I think his statements were general; they didn't exclude that possibility.

XQ. 725. Lindner describes some experiments in this article of his. The experiments with his yeast, were they conducted with yeast in a propagating vat during his growing period or some similar container, or did his experiments relate to the yeast after it had been grown?

A. His experiments related to the growing of yeast in a laboratory experiment. His conclusions were not limited necessarily by his experiments.

XQ. 727. I read the next sentence: "If moist yeast is exposed to alcohol vapor and oxygen, the alcohol is

quickly assimilated." What do you understand is meant by "moist yeast"?

A. I understand by that yeast that is moist or a liquid yeast.

XQ. 728. Do you understand that by "moist yeast" Lindner was referring to the yeast in the propagating vat?

A. As I recall those experiments, they were yeasts in a propagating vessel, not a vat, in aqueous suspension.

XQ. 729. Do you agree with the statement that in the ordinary commercial manufacture of yeast such as we have been talking about here that "provided oxygen is present, the alcohol is assimilated by yeast more readily than sugar of equal concentration; if both are present, the alcohol is taken up first by the yeast?"

A. No, I think that based on my experience, what I know, I should say that when one is considering the quantities of alcohol and of sugar involved in commercial manufacture it would be my judgment that the sugar would be assimilated more readily than the alcohol. As I have stated earlier in this litigation, under the conditions that Lindner worked, the reverse was true. But, of course, this substantiates very emphatically my statements that I made earlier that some consumption of alcohol may occur, and does occur, in the presence of sugar. Lindner goes so far as to say it takes place in larger amounts.

XQ. 730. And he was wrong, was he not, in your opinion?

A. I don't think he was wrong for the conditions of his own experiments. I think that under the conditions that prevailed in the commercial manufacture, the chances are that it is not larger, but as I have said, is a very considerable amount.

I think I have those calculations that I spoke of as to how much alcohol is evaporated during yeast

manufacture. I had them last night. I checked over—yes. It is a very rough copy and it was made on the sleeping car, so-called.

The solution was any size. The calculation was based irrespective of the size of the solution on the amount per liter; but applies to a solution of any size. I used both alcohol and water, as the materials to be calculated; one-tenth of one per cent. solution of alcohol and water by weight.

I assumed that an average of 7 to 8 cubic feet of air per minute per hundred liters was blown through this solution, which was the figure given in Dr. Free's notebook.

The method of calculation was first to compute the number of gram-molecular weights of alcohol present per liter of the solution. The next step was to calculate the number of gram-molecular weights of water present in this same solution. The ratio of these gave the fraction by which the vapor pressure of alcohol at that temperature must be multiplied to secure the vapor pressure of alcohol out of that particular solution. The ratio was 1 to 2500.

The temperature was 30 degrees—one moment. That was at 25 degrees. The ratio at 30 degrees is—no, the ratio remains the same. That is true. The ratio is the same at both temperatures, 1 in 2500. The vapor pressure, of course, is higher at 30 degrees—I took the vapor pressure as 80 millimeters; actually it is only 79, but since these calculations can't be very accurate, I took 80 millimeters as the partial vapor—as the vapor pressure of pure alcohol at 30 degrees centigrade. That gives you the vapor pressure of the alcohol, and I then found out, taking that vapor pressure of alcohol, that partial vapor pressure of alcohol, I computed the number of grams of alcohol present per liter of air, and I multiplied it by the total num-

ber of liters of air that were blown through that one liter of solution. That gave me the total weight of alcohol blown out of that liter of solution; and since in each liter there was present one gram of alcohol, I knew the percentage that was blown out; and, as I said, it comes about 8 per cent., 8 to 10. It is a straightforward calculation. Dr. Free can repeat it, I am sure.

Eight per cent. of the alcohol present was blown out. This 8 per cent. of alcohol that was blown off was not the amount that was blown off during each hour, according to my calculations. It was the amount blown off in ten hours. It, of course, represents actually, since there is only one gram, you understand that 8 per cent. means that only 8/100 gram of alcohol was blown off, and as I pointed out before, this is an upper figure. Saturation is not reached in most experiments and you don't get quite so much out.

Referring to Plaintiff's Exhibit 20, which was a process carried on in which first there was a certain amount of molasses employed and a certain yield of yeast and, second, some of the molasses was substituted for by alcohol and substantially the same yield of yeast was obtained, the exhibit states that "Yield 26 per cent. solids was 104.3 and 104.4." That is a yield of pressed yeast not corrected to standard dryness of 30 per cent., so that you want to make these figures comparable to the others that are presented in the case.

That will be a yield of about 200 per cent. on the sugar employed, assuming 50 per cent. sugar and molasses. There is about 150-odd grams of fermentable sugar in 300 grams of molasses. And the yield was about 104.

XQ. 746. How much was the yield on the basis of fermentable sugar employed?

A. Well, I am not so sure that these figures are percentages any more. I have had these recorded

usually at percentages but I am inclined to think this is—because I notice the head of the column—the column is headed "300 grams of molasses" and I suspect this is the actual weight of yeast obtained of 30 per cent. solids corrected to 30 per cent. solids from 300 grams of molasses—yes. That would be about 70 per cent. yield. I am sorry, I could have told that right at the start if I had looked at the head of the column.

XQ. 748. Is that yield, namely about 70 per cent., satisfactory from commercial considerations?

A. Well, I think you sometimes get a little higher but I would say it was a commercial yield.

XQ. 749. Seventy per cent. on the fermentable sugar?

A. No, that isn't a very good yield commercially on the fermentable sugars, 70 per cent. An ordinary commercial yield of fermentable sugar would be between a 140 or higher per cent.

XQ. 751. Can you give any explanation why such a low yield was obtained in this experiment?

A. There wasn't a very generous supply of nitrogen in this experiment.

XQ. 752. There was too much sugar and not enough nitrogen?

A. I should say for the maximum yield there wasn't enough nitrogen.

XQ. 753-4. If in a mash you had too much sugar, that is, more sugar than the yeast could consume, would you not obtain the same yield as you would from a mash in which some of that excess sugar had been removed?

A. I think the difference is rather here in not the excess of sugar so much as the deficit of nitrogen.

XQ. 755. Well, isn't that true, Doctor, that if you do have a mash in which you have too much sugar and get a certain yield of yeast, you can obtain exactly the same yield of yeast with less sugar?

A. (No answer.)

XQ. 755. (Continuing.) I meant that to be a very simple question, Doctor, namely: if you give the yeast more sugar than it can eat, won't you get the same amount of yeast if you take away some of that extra sugar?

A. Well, under the conditions of this experiment it seems to me that had there been more sugar present we would have gotten a higher yield. There still should have been a possibility of a greater quantity of yeast.

XQ. 756. Doctor, is it true that if you have in a fermenting vat more sugar than the yeast can eat, that you will obtain as large a yield of yeast, or even larger, if you take away some of that excess sugar?

A. Well, I think your question is a reasonable one but——

XQ. 757. Well, what is the answer, Doctor? What is the answer?

A. Well, the answer is that I talked that very point over with Dr. Schultz, whom I had do this experiment, and specified that we should make the conditions such that the yeast would use all the sugar it could, and then replace a part of the sugar by alcohol, and I can't believe but what that was done.

XQ. 758. Would you believe it was somewhat affected by the fact that according to your own statement you get a yield of yeast of only about 70 per cent., which is less than one-half of the yield that you ordinarily get in commercial manufacture?

A. Well, under these conditions it may well have been that a good deal of that sugar was utilized in other ways, was not properly utilized to make yeast. I should like to make further inquiries as to the exact conditions before I make any further statement about it.

XQ. 759. Will you refer now to Plaintiff's Exhibit P-21, which I understood was a wort prepared by you

in accordance with defendant's process as shown in the M-177 mash sheet, to show the conditions in that wort at the end of the sixth hour, leaving out the souring and leaving out the yeast?

A. All right.

XQ. 760. In that experiment you show that there is some ammonium lactate present, some lactic acid, some phosforic acid, and some sulfuric acid; is that correct?

A. In one of the comparative experiments ammonium lactate was present. But in the other it is not present.

XQ. 762. You came to the conclusion that there was present 2.8 cc. of lactic acid at the end of the sixth hour. Where did that lactic acid come from?

A. That came from the acidity present in the initial solution plus the smaller amount of free acidity added in the feed. The feed was slightly acid, that is to say, had a titratable acidity of 4.0, which represents what I have spoken of as lactic acid. The initial solution also had a titratable acidity of 1.5, which I have also spoken of as lactic acid, and it is the sum of those two acidities which gives the figure corresponding to 2.8 cc., .05 molar lactic acid. That lactic acid is produced exclusively from the souring operations.

XQ. 764. You also have some phosforic acid present in your solution. A quantity of 2.77 cc. From what material did that phosforic acid come?

A. That would be the phosforic acid liberated from the ammonium phosfate present in the fermenter at the start, and I believe small amounts—no, I don't think any was added in the feed in that case. So that it is exclusively the 85 pounds of ammonium phosfate present in the fermenter at the start.

When that ammonium phosfate is placed in the fermenter at the beginning of this six-hour period, the

yeast immediately commences to consume that material. That is, I think that some consumption takes place right from the start. The consumption, is both of the ammonium, which is a nitrogen supply, and also of the phosforic acid, which is a phosforus supply. There is some of the phosforic consumed in this way. Phosphorus is an important constituent of yeast. It is present in substantial quantities.

XQ. 770. How much of the phosforic acid that was formed in the fermenter by the presence of the ammonium phosphate which was put in there at the beginning, did the yeast eat up before the sixth hour?

A. Why, I think a small fraction at the sixth hour. I don't know, perhaps one-fifth of it or one-sixth of it, I don't know how much.

XQ. 772. How much growth had there been in yeast between the first hour and the sixth hour?

A. Well, there had been a considerable growth; I cannot tell you exactly.

XQ. 773. Approximately.

A. I cannot tell you that very exactly.

XQ. 774-5. About one-half of the total yield—of that order?

A. You mean 150 per cent. of the total yield had grown?

XQ. 776. No, about 50 per cent. of the total yield of yeast was grown—I am asking you—by the sixth hour?

A. I should think that was high.

Each yeast cell as it is grown assimilates and takes up phosphorus.

XQ. 778. If about 50 per cent. of the growth of yeast, that is, of the production of additional yeast cells, had been accomplished in six hours, would you say that only about one-sixth of the phosforic acid from the ammonium phosfate had been consumed?

A. I cannot tell that right offhand, but I might say it depends upon how much excess of phosfate was present for the whole requirements. There is also some phosforus present available from the other mash ingredients.

I have never made up a wort corresponding to defendant's wort and measured the amount of phosforic acid present during any time of the first six hours.

In this Plaintiff's Exhibit P-21 I assume that all the phosforic acid which could possibly be liberated from the ammonium phosfate that was put in in the beginning is still in the solution at the sixth hour. I have neglected the amount of phosforic acid consumed by the yeast in that first period because I felt it was of small consequence.

I am sure it is not 50 per cent. of the entire amount of phosforic acid. It might be 20 per cent. These experiments were for comparative values, as you understand, and the same treatment was accorded both solutions. So that it involved no confusion, or it involved no attempt to secure results that were not perfectly evident.

XQ. 783. But it would make a difference, would it not, Doctor, in the range of acidities shown? That is, as to the starting point and the final point?

A. It may have made a slight effect, yes.

XQ. 784. I have here, Doctor, the reports regarding the operation of the Fleischmann Company concerning which Mr. Luce and you both testified, as shown in Defendant's Exhibit D-9, and which shows the growth of the yeast during the propagation period, and about how much is grown during that operation. It shows on the laboratory sheet No. 2651 at the start there is, leaving out decimal points, 4 grams, then 5 grams, 6, 9, 11, 13, 14, 16, 16 and 16. Do you consider

that that is a typical showing of the growth of the yeast in such processes as those we have been talking about?

A. May I see the sheet, please? (Sheet handed to the witness.) May I also see the other one, the mash sheet?

XQ. 785. M-177 (handing to the witness)?

A. Yes. The operation in this propagation of yeast was on a considerably more rapid schedule than that in M-177. This propagation was completed after ten hours, ten or eleven hours, while the one in M-177 was 16 to 16½ hours. The start of the operation is not shown clearly in this Exhibit D-9, but it seems to have been at 12:15, in which case, if we go to the same fraction of the operation, we should go a good deal less than six hours, or somewhat less, not a good deal, and we might go, for instance, to four hours where the yield would be 5.99 or rather 11.2—no, 9.14 out of 16. Now, this may include the seed yeast also, it is not perfectly clear, but if it includes the seed yeast then the start would be at 1.15 and we should have to subtract from all these values four six seven, and then we would have a yield at four fifteen of about 40 per cent.

THE COURT: A day or two ago in discussing some of the phases of this patent the statement was made, I think, by counsel here, or perhaps it was on the witness stand, to the effect that one learned in the art would understand while one not learned in the art would not understand, and a friend of the Court happened to be in court one day and left a case for me to read this morning bearing upon it. The case is Chemical Rubber Co. v. Raymond Rubber Co., Circuit Court of Appeals of the Third Circuit, December 11, 1895, 71 Fed. 179, wherein is quoted the language of the United States Supreme Court in Tyler v. Boston:

"Where a patent is claimed for such a discovery, it should state the component parts of the new manufacture claimed, with clearness and precision, and not leave the person attempting to use the discovery to find it out 'by experiment.' The law requires the applicant for a patent right to deliver a written description of the manner and process of making and compounding his new discovered compound."

Now, as to this idea about being skilled in the art; "The art is new; and therefore persons cannot be presumed to be skilled in it, or to anticipate the results of chemical combinations of elements not in daily use."

And then quoting further in that same case, the Supreme Court decision, Consolidated Electric Light Co. v. McKeesport Light Co., we find this language: "The object of this is to apprise the public of what the patentee claims as his own, the courts of what they are called upon to construe, and competing manufacturers and dealers of exactly what they are bound to avoid. Grant v. Raymond, 6 Pet. 218, 247. If the description be so vague and uncertain that no one can tell, except by independent experiments, how to construct the patented device, the patent is void."

Now, I simply raise that at this time because, of course, there has been no law cited in this case up to the present time, but as I say, this case was brought to my attention and I will want counsel to point out before we finish why it was necessary for us to have the experiment we had here, whether or not being necessary it does not fall within the language of these two decisions of the United States Supreme Court which I have just quoted. I am not asking you to make any argument on it at this time but I think in fairness I should call

your attention to this case, it is running through my mind.

MR. WATSON: We shall be happy to do so, if the Court please. Of course, the patent is addressed to those skilled in its art.

THE COURT: Yes, but it has got to be so stated that it is not necessary to conduct outside experiments to explain it.

MR. WATSON: The disclosure has got to be operative.

XQ. 786. If there was in defendant's process, as shown by the sheet M-177, about 40 per cent. of the yeast grown at the end of the sixth hour, you should have put in your wort only about 40 per cent. of the phosforic acid that you used, isn't that so?

A. No, because there were other sources of phosforic acid other than ammonium phosfate which could have been drawn on and presumably were drawn on. There is nothing stated in this memorandum, Plaintiff's Exhibit 21, about there being other possible sources of phosforic acid than the ammonium phosfate. I didn't think that was necessary and I don't think it is necessary now. It is known that there are phosfates in these other nutrients that are employed.

XQ. 788. Now you conducted this set of parallel experiments upon this wort that you considered like defendant's wort, one with ammonium lactate and the other without ammonium lactate, and you obtained different acidities measured in pH and you have two tables showing a comparison; the differences range from .15 of a pH unit, that is, a tenth and a half of a pH unit, at the beginning to .27 at the end. Is not .27 the largest difference that there is?

A. Yes, it is slightly larger, .26, because of the 4 cc. added—one unit larger.

XQ. 789. Now, what practical importance, Doctor, is a difference of .2 of 1 per cent.? In the practical operation of yeast, Doctor.

A. Well, I think I can make that clear. In the first place, the presence of the ammonium lactate gave a somewhat higher pH, a somewhat less acid solution, to start with, let us say after the phosforic acid had been added to both, confining ourselves just for the moment to the sulfuric acid. That is, we see that with the ammonium lactate, the pH was 3.7 as against 3.5, a difference of two-tenths of a unit. That means that with the ammonium lactate the acidity was .2 pH units less, and that in itself is an important difference. If one understands what pH units mean, of course, they are a logarithmic relation, and .2 means that approximately there is 50 per cent. less acidity, less hydrogen ion concentration in the 3.7 than in the 3.5. In a second respect, this efficacy of the ammonium lactate comes to light. In the case of the solution without the ammonium lactate, it required only eight cubic centimeters to pass from the initial acidity of 3.5 down to the 3.0, representing very considerably greater acidity. To go from 3.70 down to 3.0, with the ammonium lactate, required 13.6 cubic centimeters of acid. On their overall basis then, the solution with the ammonium lactate was nearly twice as effective in preventing the growth, the increase, of acidity in the solution. That is on the overall basis, counting both the first and second effect. If we wish to restrict it to this second effect that I mentioned, we can see that the point of 3.50 was reached with the ammonium lactate at about 3 cubic centimeters addition of sulfuric acid. So that in passing from 3.50 to 3, 10.6 cubic centimeters of acid was required in the case of the solution with ammonium lactate as against 8 in the other case, or a 50 per cent. superiority. In other words, one must not be confused by these pH units;

one must remember that they are on a logarithmic scale, and that 3 units in the first decimal place, that is .3, means a hundred per cent. difference in acidity. This shows very clearly——

(Recess.)

THE WITNESS: Mr. Philbin, I would like to correct my testimony on those figures. I have now found that my first interpretation was correct. I have consulted with Dr. Schultz who made the experiment; 104.3 is the per cent. of yeast first obtained. It is based on the 26 per cent. of solids.

XQ. 790. Referring to Plaintiff's Exhibit 20——

A. Unfortunately the memorandum did not state whether it was percentage or grams and I guessed one way and then another way and my first guess was right.

XQ. 791. I have here a copy of a Patent 1,745,693, Hickson, et al., issued to Standard Brands, Inc., which states, page 2, line 7: "The optimum hydrogen-ion concentration for the growth of yeast is in the neighborhood of pH = 6." Does that agree with your understanding?

A. No, it does not, not in this type mash or in this type of process under discussion.

XQ. 792. You said (Tr. 427) in referring to some of the work of Dr. Free that he used dilutions of 40,000, 60,000 and 80,000, and you thought that the dilution in defendant's wort at the end of the sixth hour was something over a hundred thousand. Upon what do you base your view, that it should be something over a hundred thousand?

A. I base it on my actual calculations of the amount of molasses wort, water and so forth, employed.

XQ. 793. How much water?

A. Well, that will take some little thought. That figure is based on an initial volume of diluted solution

in the fermenter of 9250 gallons, which is the figure furnished us in defendant's answer to interrogatories. I then added to that the amount of feed added after six hours, which was 600 gallons, and that represented a total volume of the solution in the fermenter.

XQ. 794. Where did you get that 9250 figure?

A. That is for one-fourth of the 37,000 gallons that defendant's interrogatory gave which, plus 600, made 9850 gallons as the volume in the fermenter at that time.

XQ. 795. So far, Doctor, you have gotten 9850. Where are the other 90,000 odd gallons?

A. Now, that corresponds to the amount of molasses that has been added to the fermenter at that time, which is 35.5 per cent. of the total, or .355 fraction of the whole. Based then on the total molasses, because that is the way I understood Dr. Free to give his figure, I divide 9850 by .355 and I get 27,700 gallons for this fermenter. Multiplying by 4 gives me the total volume for the whole four fermenters, or 110,800 gallons as the total volume for the molasses, all the molasses at the sixth hour. As far as I can see that is a correct calculation.

I did not state that my calculation was on the basis of a fermenter holding about 27,500 gallons. It was based on a fermenter holding 10,000 gallons. Four fermenters.

XQ. 798. If you have four fermenters, each holding 10,000 gallons, it does not seem to me you will ever get more than 40,000 gallons.

A. Well, I don't think I have said that we would. I interpreted this figure of dilution to represent the volume of solution that would have contained all the molasses in use at that time, on the same basis as Dr. Free, which was for the total molasses; that is, I wanted to get a figure comparable to Dr. Free's, which was the number of gallons for the total amount of

molasses. I didn't use the total amount of molasses. At that stage in the game there was only 35 per cent. of the molasses in the fermenter at the time. I had to allow for that. But allowing for that and reducing to the same basis as Dr. Free, of course, I have a greater dilution than he had, because I haven't as yet introduced all the solution, it comes out that actually the equivalent concentration, or, if you prefer to put it the other way, the equivalent dilution, prevailing at the six-hour interval was 110,000 gallons for the total molasses—a perfectly correct figure, so far as I can see.

XQ. 799. Is calcium carbonate a basic salt?

A. It is not spoken of as a basic salt, no. If you are using it in a technical sense, it is not a basic salt; if you are using it in a functional way, I think you can say that it does have neutralizing properties and in that sense is alkaline or basic.

If tartaric acid and carbonate of potash are combined there will be produced potassium tartrate. If tartaric acid and bicarbonate of soda are combined there will be produced sodium tartrate. I think that the action perhaps hardly goes to absolute completion but that will be the chief product formed.

XQ. 802. If either potassium tartrate or sodium tartrate is added to a solution containing a mineral acid will either reduce the acidity on the pH scale?

A. Well, I should have to look up the strength of tartaric acid to answer that; I cannot tell you offhand. It all depends certainly. Tartaric acid is weaker than sulfuric acid.

XQ. 804. Would it reduce the acidity on the pH scale of a solution containing sulfuric acid if either potassium tartrate or sodium tartrate were added?

A. It would over certain ranges, over certain concentrations of sulfuric acid. I cannot tell you, as I have said, exactly because one has to know the strength of the tartaric acid, but there would be concentrations

of sulfuric acid where you could reduce the acidity by adding potassium or sodium tartrate to it.

XQ. 805. I find in the abstract of the Henneberg article, which is in evidence, the following statements:

"The author has carried out an extensive series of experiments which show that rye or wheat-meal, egg albumin, peptone, lecithin and inorganic ammonium salts exhibit striking similarities in their action on yeasts. These substances are . . .; (3) non-poisonous in supply water; (4) non-poisonous in sucrose solutions, if calcium salts, carbonates or bases are present in small amounts . . .; and are (5) of great nutritive value in presence of the substances mentioned under (4)."

I also find the statement that "Under ordinary conditions, these nitrogenous substances form excellent nutrient materials for yeasts, their injurious action only appearing in the absence of certain salts which are more especially compounds capable of neutralizing acids."

And I also find the statement that "the nitrogenous compounds give rise, in the interior of the cells, to free acids, which, under normal conditions, are immediately rendered innocuous by the above-mentioned salts; if such salts are lacking, the acids exert a poisonous action on the cells."

Can you tell us whether it was known before Hayduck that inorganic ammonium salts could be used for yeast salts?

A. Ammonium salts had been used as an ingredient in culture experiments in which minute specimens of yeast were grown for scientific purposes and also in the initial stages in the preparation of seed yeast. I don't know of any extensive use of inorganic ammonium salts.

XQ. 806. Had that been proposed for use as yeast nutrients in yeast manufacture?

A. Not in significant amounts.

XQ. 807. Was it known that inorganic ammonium salts was a food for yeast?

A. It was known that yeast could assimilate small amounts of these salts, I think that is fair to say, under special conditions. I wouldn't be prepared to go any further than that.

XQ. 808. Was it also known that these inorganic ammonium salts would produce free acids which harm the yeast?

A. I think this reference you speak of here points out that an injurious action which had been observed with ammonium salts could be remedied by certain salts which are more especially compounds capable of neutralizing acids. You just read me that phrase.

XQ. 809. Was it also known that the injurious action of these inorganic ammonium salts would be neutralized in the presence of certain salts?

A. In this very reference which you have just read there is a vague hint to that effect. The neutralizing, however, which Henneberg has in mind in this reference, which is clear from a study of his other papers, was a neutralization largely by virtue of the calcium or lime that was present, wholly independent of any acidic effect or any effect on the acid. That was a question that yeast growers and physiologists were much interested in at the time, the peculiar efficacy of calcium, whether basic or acid or whatnot, on yeast growth and metabolism; and Henneberg found the strangely efficacious effect of calcium salts, both acid and alkaline in their effects, on yeast growth. To bring this out in certain of his articles, he doesn't use the word "neutralizing" as such, just without explanation, but puts it in quotation marks to indicate that it isn't a mere neutralization of acid that he has in mind, but the neutralization due to the calcium that is present. Subsequent investigations have confirmed it. We know that the

presence of calcium ions in solution has a marked effect on the stability of the colloid constituents of the solutions, on the permeability of the yeast cells, and that it is through this effect on the permeability of the yeast cell wall that this result of lime and of calcium salts that Henneberg observed in these scientific experiments is based; and the yeast maker wouldn't have been deterred a bit anyway if he had known that acids were liberated under these conditions. Acid was what he wanted in his commercial manufacture of yeast. It was recognized that you have got to have acid; the one thing that must not be done in a yeast factory was to use an alkali; you must not do anything where you run the danger of destroying your acidity. That has been brought out in this case already, and it should be emphasized.

XQ. 810. Do you understand that Henneberg wrote this article?

A. No, I don't think he did.

XQ. 811. Now, Doctor, confining ourselves to what this article itself says and not to what you say Henneberg may have written in some other publication, does not this article say that inorganic ammonium salts can be used as yeast foods, that they will produce injurious acid, and that such acidity can be neutralized by certain salts?

A. I don't see where he says that inorganic ammonium salts can be used as yeast food in any commercial manufacture, if that is what you mean.

XQ. 812. Is your only distinction between the '103 patent and this abstract, that this abstract does not say that these inorganic ammonium salts can be used for commercial manufacture?

A. No, I think there are other objections. The inorganic ammonium salts that are mentioned here as having a deleterious effect only have that in distilled

water. This very reference brings out the fact that if you use ordinary water you don't have these troubles.

XQ. 813. I find in the same statement: "Under ordinary conditions, these nitrogenous substances form excellent nutrient materials for yeast, their injurious action only appearing in the absence of certain salts which are more especially compounds capable of neutralizing acids."

A. That is to say in distilled water.

XQ. 814. Do you understand ordinary conditions to be in distilled water?

A. No, far from it; but he says under ordinary conditions they form excellent materials for yeast, their injurious action only appearing in the absence of certain salts; that is, in conditions that are not ordinary—to wit, in distilled water—as appears from a study of the articles themselves. That sentence itself answers your question, I think.

XQ. 815. I think so, too. Do you think that Hayduck discovered the principle that deleterious acidity could be neutralized?

A. No——

MR. WATSON: In what, Mr. Philbin? Do you mean the scientific principle that acid could be neutralized?

MR. PHILBIN: That was the way the question read.

A. If it means the scientific discovery that acids could be neutralized by bases, Hayduck did not make that discovery.

XQ. 816. Do you think he discovered that in yeast manufacture where there was undesirable acidity, it should be neutralized?

A. Yes.

XQ. 817. And that he was the first to discover that in yeast manufacture, when you had too much acidity, it should and could be neutralized?

A. Yes, and he went against the combined opinion and teaching of his times.

XQ. 818. And you understand that is the principle upon which this Hayduck '103 patent is based?

A. It is based on the fact that you can indeed get good yields of yeast in a yeast factory if you neutralize the deleterious acidity developed from ammonium salts.

XQ. 819. Now, you referred to the Rainer patent. Does that patent teach that you do not have to add all the yeast nutrients at one time, or instead you can add them from time to time as may be required?

A. This Rainer patent states that you can make subsequent additions, usually quite small additions, of nutrient materials after the nutrient materials already present have been consumed.

I will point out the sentence or sentences in the Rainer patent which limit it to adding fresh nutrient material only after all the nutrient material which is in the fermenter has been consumed. On page 5 of the translation in the middle paragraph "when after six to eight hours the added dextrose or other kind of sugar has been wholly or for the most part consumed in the growth of the yeast, a further portion thereof amounting to 1/20 to 1/10 per cent. is added and similarly the peptones after they have been consumed may be added in portions or run into the nutrient liquid slowly and continuously" and so forth; and I think there are other similar references.

XQ. 822. Please read them—never mind now.

A. I think there is one other place but I would have to hunt for it.

XQ. 823. Is that all, Doctor?

A. Yes.

XQ. 824. Does the Rainer patent give certain specified examples of rate of feed and proportions and temperatures and Ballings—it does, does it not?

A. Not clearly or certainly, no,—quite confused, in fact.

XQ. 825 You mean it confused you?

A. Yes, I have heard a great many people testify to that. It has been the universal verdict even of the people who have argued in favor of this reference in other litigations, that it was confused.

XQ. 826. Do you consider that the Rainer patent is limited to specific teachings of the rate of feed and proportions?

A. I hope not.

XQ. 827. You wouldn't consider that it was so limited, would you?

A. I don't know what you mean by that, Mr. Philbin.

XQ. 828. If you were reading that patent, in order to obtain information from it, and you were endeavoring to practice that patent and use whatever data it had in it, would you necessarily follow the specific instructions of the patent?

A. I think one should try to study the patent and see if there is a clear principle or idea there set forth and then should be guided by the central idea of the patent and the specific cases might serve as an illustration.

MR. PHILBIN: That is all.

RE-DIRECT EXAMINATION BY MR. WATSON:

RDQ. 829. Will you put on the record, Dr. Lamb, the yeast yield obtained in the tests you had made following defendant's mash 177.

A. In the two experiments or tests in which we strove to simulate defendant's operations, using ammonium lactate with Fleischmann's yeast, a yield of 84.3

and 84.4 per cent. respectively was obtained, 27 per cent. solids.

That is on the basis of raw mateials. And using National Grain yeast the other two experiments gave respectively 75.9 per cent. yield and 80 per cent. yield, also 27 per cent. solids.

RDQ. 831. On page 442 of the record you spoke of 3 to 5 degree Balling solutions having been used before Hayduck's date. Did you refer to the straight-set processes there?

A. Yes, I did, as contrasted with the Zulauf process.

RDQ. 832. Can you tell me what per cent. of a 12 degree Balling concentrate would be taken for dilution to 1 degree Balling to provide a calculated mean of 5 degrees?

A. May I select the size of fermenter so that I can——

RDQ. 833. Oh, yes.

A. —make it simpler?

MR. PHILBIN: Perhaps we could have that calculation later and put it in the record.

MR. WATSON: That is quite satisfactory. I want to note on the record also that the Hickson patent referred to by Mr. Philbin had a filing date of January 14, 1921, issued February 4, 1930.

A. About 13 per cent.

I was asked about quantities of seed yeast. Variations in the amount of seed yeast used with given materials, given wort, would affect the duration of the propagating process.

RDQ. 835. Would it materially affect the yield?

A. Not greatly, the over-all yield, no.

I was asked about the disclosure of the '105 patent on the matter of the amount of seed yeast and the kind of starting materials. Suitable starting materials for

yeast manufacture, for nutrient materials, or suitable amounts of seed yeast were well known to the practical workers at that time.

On page 459 of the record in my answer at the bottom of the page I spoke of the manufacturer "would know what was a high yield, based on operations outside of this patent." I meant "based on" in the sense of calculated.

RDQ. 838. That is, in the sense compared with?

A. Yes.

In these yeast manufacturing processes, such, for example, as shown in the defendant's mash sheets in evidence, the readings of Balling during the process are affected somewhat by yeast in suspension.

RDQ. 840. On page 457 of the record appears this question: "With respect to this 3 to 5 so-called principle, does that have anything to do with the rate of feeding the nutrient solution into the fermenting vat? A. No, it does not."

Does that express your full position in the matter?

A. Well, I think that statement is correct provided one is merely considering the calculation itself on the preparation of the solutions to be used for propagation. In that sense the statement is entirely correct. Of course, one must remember that once having gotten the solutions, a concentrated or dilute, or a large or a small solution might require a different rate of feed. That is almost self-evident.

RDQ. 841. Is yeast growth in these commercial operations by arithmetical progression or geometrical?

A. Well, it approaches the geometrical in the early stages.

Mr. Watson: That is all the re-direct.

Mr. Philbin: That is all.

Mr. Johnson: If your Honor please, I have a sheet on which I have calculated the amounts of molasses used by Dr. Free in setting his fermen-

r, and the additions of molasses at the various intervals indicated in his Experiment 10 repeated and Experiment 1. Some of these figures have been checked, and I am putting them in now, asking the reporter to copy them into the record, subject to correction if any error is found, merely in order that we may have the percentages calculated, because Dr. Free diluted various portions of the added molasses.

Sheet referred to follows:

Free — Exp. 10 repeated June 11, 1935.

	% sugar on volume	Approx. %
To set fermenter 518 gms. of molasses	0.25	1/4
Additions of molasses		
3rd hr.	0.269	1/4+
6th hr.	0.308	1/3—
9th hr.	0.462	1/2—
12th hr.	0.308	1/3—

Free — Exp. 1 May 14, 1935.

	% sugar on volume	Approx. %
To set fermenter 514 Grams of molasses	0.25	1/4
Additions of molasses		
1st	0.308	1/25
2nd	0.053	1/20
3rd	0.069	1/15
4th	0.1	1/10
5th	0.114	1/9
6th	0.131	1/8
7th	0.146	1/7
8th	0.152	1/7+
9th	0.182	1/6

MR. JOHNSON: And plaintiff offers as Exhibit P-24 a translation and a photostat copy of pages

347 to 349 of Delbruck "Illustriertes Brennerei-Lexikon," which was referred to by Dr. Lamb this morning, this portion being entitled "Hefefabrikation" or yeast manufacture.

MR. PHILBIN: May I ask the pertinency of this added exhibit?

MR. JOHNSON: That eliminates any question of doubt, if any doubt remains, as to what the yeast-manufacturing art knew as of a date in January, 1915.

(Received in evidence and marked Exhibit P-24.)

MR. JOHNSON: Plaintiff also offers as Exhibit P-25 a copy of the King patent, 2,008,584, issued July 16, 1935 to defendant, the National Grain Yeast Corporation, on an application filed February 4, 1931.

MR. PHILBIN: May I ask the pertinency of that exhibit?

MR. WATSON: Well, it has the same purpose, Mr. Philbin, as I imagine the purpose of your reference to the Hickson patent. There are some statements in the patent which are quite contradictory to some of your arguments, as I have understood them, perhaps some of the testimony of your witnesses.

MR. PHILBIN: Will you point them out?

MR. WATSON: Sure.

"The addition of aqua ammonia during the prolonged period of souring, and the resultant combination of same with the various organic acids formed, result in an accumulation of chemical substances with the so-called Buffer properties.

Namely, these substances restrict and hold within desirable limits the formation of free hydrogen ions or ionizable acid radicals which is very important especially during the latter stages of yeast propagation."

(Received and marked Exhibit P-25.)

MR. JOHNSON: Plaintiff also asks that Exhibits 17 and 18 previously marked for identification, the first being a photostat of a mash sheet of the Liberty Yeast Corporation dated May 19, 1923, and the second being a photostat of Liberty Yeast Corporation mash sheet dated January 8, 1923, be marked as exhibits in evidence.

MR. PHILBIN: As I recall it, your Honor, those exhibits were marked for identification because these mash sheets of 1923 were supposed to have some relation to what Hayduck's application of 1915 meant when it was written. I couldn't see the pertinence of it then and I do not now.

MR. JOHNSON: They were marked for identification at that time—they were used among other things, if your Honor recalls, to refresh the recollection of the witness Rautenstrauch as to the densities during the Liberty Yeast processes.

THE COURT: Mark them in evidence.

(Received and marked Exhibits P-17 and P-18.)

MR. WATSON: With the consent of defendant's counsel, we will put in a table of the prices of materials which we are having difficulty in getting from Government sources. As soon as that is received we will enter it on the record.

Plaintiff Rests in Rebuttal.

DEFENDANT'S SURREBUTTAL PROOFS.

EDWARD E. FREE, recalled on behalf of the defendant in surrebuttal, testified as follows:

DIRECT EXAMINATION BY MR. PHILBIN:

Q. 255. Dr. Lamb referred to your experiments with respect to alcohol, particularly experiments 14 and 15, and Dr. Lamb also referred to an experiment on his part or by one of his assistants, shown as plaintiff's Exhibit P-20, and also talked about some calculations with respect to alcohol in yeast. On page 663 of the testimony Dr. Lamb stated that "Dr. Free's own experiments showed in Table 4, at the bottom of page 52 of his notebook, that analyses were made of sugar in this wort during these intervals, and while there was a drop in the amount of sugar present at the tenth hour as compared with the eighth, there was still significant amounts of sugar present in this wort, and that therefore some alcohol was being consumed in the presence of sugar. Moreover, some of the sugar was consumed, because in every case there has been a drop in the sugar amount at the tenth hour as compared with the eighth. Then on the basis of these very experiments we see that at least some alcohol has been consumed during this period along with the consumption of some sugar, which is precisely the position that was taken by the plaintiff in this case, and is expressed in the Hayduck patents."

Will you please state whether your experiments showed that some alcohol was being consumed by the yeast in the presence of sugar?

A. I would not so interpret them, that is, I disagree with the interpretation of Dr. Lamb in this instance.

I believe those experiments 14 and 15 are shown in the notebook of mine which is in evidence.

Q. 257. Is there any showing here because of the difference in the amount of sugar at the eighth hour and tenth hour to justify the conclusion that the yeast was eating alcohol?

A. I don't think they justify that conclusion but I think I see what Dr. Lamb based his conclusion on, that is, the fact that at the eighth hour the feeding of sugar had just ceased and accordingly the determination of sugar made at that time, determination of sugar in the solution, naturally showed the presence of a small amount of sugar which had just ceased being added. Now, during the next hour or half hour or period of time that additional sugar would, of course, be consumed, according to my interpretation; until that additional sugar, that residual sugar I might call it, has been consumed, there would, according to my interpretation, be no consumption of alcohol, but there would be, of course, a period subsequent to the consumption of all of that sugar when there would be no fermentable sugar in the solution, and accordingly alcohol consumption might and probably did take place.

There is one other thing I should mention, that perhaps is not sufficiently clear in the notes. The determinations, chemical determinations, of sugar are determinations of what are chemically called reducing sugars, that is to say, substances which reduce the copper re-agent and are measured in that way. Now, naturally some of those sugars are not fermentable by yeast. There are varieties of sugar which yeast will not eat under any circumstances. Accordingly, the fact that there is a figure at the tenth hour showing the presence of something marked sugar, does not mean that there is any fermentable sugar left at the tenth hour. I think perhaps that explains the discrepancy between Dr. Lamb's interpretation and my own.

Q. 259. Dr. Lamb also testified with regard to Plaintiff's Exhibit 20, which showed the operations

with molasses and production of yeast and then an operation without as much molasses but adding some alcohol, with about the same yield of yeast. Does the fact that you obtain about the same amount of yeast, first with only molasses and second with less molasses and some alcohol, show that the yeast has been eating alcohol?

A. Well, I didn't hear the testimony and it would take some time to study this, I am afraid, but let's take a purely hypothetical situation. If you make one experiment in which you have sugar alone and get a certain yield, and you make another experiment in which you have a portion of that sugar replaced by alcohol and get the same yield, that does not in my judgment necessarily prove that the yeast has consumed, has assimilated, the alcohol; because something is limiting the growth of the yeast in any experiment. Now, that something may be time, it may be the natural characteristics of the yeast, it may be the absence of food, it may be the presence of poisons, it may be many things. Now, in this instance for example, if the growth of the yeast in the experiment were limited by something other than the amount of sugar present in the first experiment, that is to say, if the yeast had more sugar than it needed, but its growth was limited by something else, then the mere substitution of a certain percentage of that sugar by alcohol would not necessarily have any effect upon the yield of yeast, because the yeast yield would still be limited by whatever the factor was that was limiting it. Now, of course, I would not like to be understood as claiming that this actually was the case in Dr. Lamb's experiment, but we have made experiments ourselves which showed that same result, and it is not at all an improbable thing to happen. Such a limiting factor could be the absence of enough nitrogen.

Q. 261. Dr. Lamb referred to an article in the Monthly Review of 1928 of the Journal of the Institute of Brewing, referring to a communication by one Lindner in which was the statement: "Provided oxygen is present, the alcohol is assimilated by yeast more readily than sugar of equal concentration. If both are present, the alcohol is taken up first by the yeast. If moist yeast is exposed to alcohol vapor, and oxygen, the alcohol is quickly assimilated and the fat content of the cell can rise from 3 to 30 per cent. on dry matter." What is your view of those statements in relation to the yeast manufacture?

A. Well, if this should be interpreted as meaning in the manufacture of yeast under ordinary conditions in solution, yeast would assimilate alcohol in preference to sugar, I think it is unquestionably wrong. That is not Professor Lindner's present opinion, and it is an opinion which unquestionably is incorrect under any circumstances. I suspect, however, that, while I have not looked up this original article since the first time I have seen it, I suspect that this refers to some well-known experiments of Lindner's with the behavior of yeast in contact with the vapors of alcohol, moisture, and what not, not in solution at all. That is, growing the yeast in moist form, but substantially solid form, in contact with a moist atmosphere. Lindner did a long series of such experiments, and from the reference here to the moist yeast being exposed to alcohol, vapor and oxygen, I suspect that this is an abstract of some portion of that work. However, I don't mean to assert that, because as to that we would have to look up the original paper and see just what it is. Perhaps the simplest thing is to say that if Lindner means that alcohol is consumed preferentially to sugar, in ordinary solutions, then he is unquestionably wrong. I hate to disagree with Professor Lindner, if I am doing so, but

the facts are so clear that there can be no mistake about that; because—well, for example, a very simple thing: if you grow yeast in a solution of sugar, containing a certain small amount of sugar, if you grow yeast in that solution you always get a certain amount of alcohol formed; that is, no one ever has succeeded, to my knowledge, in growing yeast without some production of alcohol. Now, of course, that doesn't prove that yeast never assimilates any alcohol, but certainly if yeast were assimilating alcohol in preference to sugar, there would be no alcohol left under such conditions. The alcohol would all be used up. I am not urging this argument at all as against Dr. Lamb's view that alcohol may be used by yeast under some conditions, but it certainly is against this view credited to Professor Lindner in this abstract.

Q. 262. Dr. Lamb made some calculations, he stated, with respect to the evaporation of alcohol and came to the conclusion that about 8 per cent., as I recall it, of the alcohol would be evaporated, instead of, as you testified, about 50 per cent. Have you any comments to make upon his method of calculation as you heard it?

A. Well, as I understand Dr. Lamb's testimony, which I heard this afternoon, he took the vapor pressures, partial vapor pressures, alcohol, and water, that is the amounts of alcohol and water which would pass from the liquid into saturated air, and he calculated from that, taking the quantity of air passed through the fermenters, in our experiment, he calculated from that the percentage, the amount of alcohol, and then the percentage of alcohol, which could be removed under those conditions. He obtained a figure of one-sixth of what we actually found by experiment. We made that same calculation, or a similar calculation, when we were originally planning these experiments; because we thought

that if we could calculate the amount of alcohol which would be lost due to evaporation, that would save the necessity of making the laborious blank experiments. Unfortunately, I don't have the results of that calculation, we didn't take it seriously, and we threw it away. I will explain in a moment why we didn't take it seriously. But my recollection is that we got a very much larger figure than Dr. Lamb got. Now, of course, I cannot say right at the moment why Dr. Lamb and I don't agree about this. We no doubt could sit down for an hour and find out why we don't agree, and accordingly I am not disposed to attack his calculation at all, since I don't know, I don't remember exactly, what our calculation was. I don't believe it, but I am not disposed to attack it. However, I would like to point out in this connection two things: In the first place, why we rejected this method of calculation and considered if unsatisfactory. That is because a number of factors other than the simple vapor pressure relations have to be taken into account in these experiments. One of them, for example, is the size of the bubbles of air. Now, actually, as you blow air through liquid of this kind, you have a kind of froth, like the foam on a stein of beer, which is composed of a lot of very fine air bubbles mixed with a solution. Now, it is known physically that the vapor pressure and evaporation of evaporatable substances is different, depending upon the curvature of the surface from which they are evaporating. That is to say, if you have evaporation from a flat surface, that is one thing; if you have evaporation from a tiny bubble, with a greatly curved surface, or on the other hand, evaporation from a solid particle, or a liquid droplet, with a highly curved surface, you get a different vapor pressure condition. That is well known and, of course, it would be necessary to evaluate that in making a correct calculation of this kind.

Now, secondly, the presence of other substances in the solution affects the vapor pressure relations; and here we are dealing, of course, with many other substances in the solution, the molasses and all of its constituents, the grain and its constituents, et cetera. Those, of course, those effects, could be evaluated by experiment without any difficulty, but it would not be safe to evaluate them by guesswork. Thirdly, the evaporation from the exposed surface of the liquid in the fermenter also must be taken into account, and it is extremely difficult to evaluate because that exposed surface is varying continually due to the foam which is formed on the surface. Now, fourthly, the concentration of alcohol in the solution during the progress of the experiment is not constant. It increases due to the formation of alcohol by the activity of the yeast, and it decreases due to the evaporation of alcohol, and, on the theory of Dr. Lamb, due to any absorption or assimilation of alcohol which might take place by the yeast. Therefore, the whole calculation impressed us in the beginning as being so uncertain and requiring so many corrections that we decided not to depend on it, and we decided to make an actual experiment under exactly the conditions used; that is to say, a blank, run a blank, under precisely the same conditions as used before. Now, we did run that blank, in fact, we ran it in duplicate, and we got a certain result, and I would still maintain in spite of all the theories that might exist, that under a complex condition like this, an actual experiment, carefully done and repeated, and with concordant results, is more important than theories. Now, I must say that I don't wish to attack Dr. Lamb's calculation, because I don't know on just what basis his was made, but even if it is absolutely correct, I still don't believe it because the experiment seems to me to be more significant.

Q. 263. You made some experiments with respect to the effect of ammonium lactate in worts such as de-

fendant's and Dr. Lamb criticised those measurements on several grounds, first that you added sulfuric acid in small amounts in successive doses to some of this untreated wort and then took measurements, the conclusion reached by Dr. Lamb being that "the conditions selected by Dr. Free were such that the results he obtained were without immediate significance to the question at issue. In other words, that he selected conditions under which the efficacy of ammonium lactate could hardly have been expected to disclose itself." (Tr. 426.) What is your comment upon that?

A. Well, I don't know just why the conditions are supposed not to be satisfactory. We took conditions which we believed and which I still believe to represent what was happening in the wort. The addition of sulfuric acid progressively bit by bit is exactly what does happen in the wort as the ammonium sulfate is decomposed. Dr. Lamb's criticism amounts to a general one —I didn't hear his testimony. All I can say is I still believe what I said before.

Q. 264. Dr. Lamb suggested (page 427) that you should have taken the conditions at the end of the sixth hour instead of taking the over-all conditions.

A. Well, we took the over-all conditions because they represent, according to our calculation, the condition where the danger of acidity, over-acidity would be the greatest. You see, the ammonium sulfate is not added all in the beginning, it is added gradually during the yeast propagation and it is decomposed gradually. Accordingly, during the early part of the yeast propagation the amount of ammonium sulfate present is not the total quantity and even the quantity present has only been in part decomposed, so that the maximum danger from the sulfuric acid, in my judgment, would come toward the end of the fermentation process rather than partway through. Now, I might say that that ex-

plains also the question of dilution which I heard Dr. Lamb testify about today, in which he thought that we should have had a greater ratio than the 80,000 gallons dilution because of conditions at the sixth hour. Well, if allowance is made for the amount of ammonium sulfate present and decomposed at that period it will be found that the dilution ratio should be in the neighborhood of 65,000 or 70,000 gallons instead of 100,000 gallons and accordingly our maximum dilution ratio of 80,000 gallons was, in our judgment, substantially beyond any dilution ratio which could occur under ordinary conditions in practice.

Q. 265. Dr. Lamb also said you did not take into account the presence of lactic acid. What have you to say as to that and that that was "an added blemish on the experiments although not so serious a one." (Tr. 428.)

A. Well, I suppose that what Dr. Lamb had in mind was the lactic acid which might conceivably be produced in the fermenter by the decomposition of ammonium lactate. Well, I haven't understood that it was the contention of the plaintiff that that would happen because my understanding was that they claimed ammonium lactate to be a neutralizing agent, in which case, of course, they would have to assume that the ammonium lactate, instead of producing acid in the solution, would produce alkali. However, if it be assumed on the other side that the ammonium lactate is not a neutralizer but is an acid-forming salt in the same way that ammonium sulfate is, I still don't think that we should have added the ammonium lactate—I mean the lactic acid—to our solutions because the effect of lactic acid is very small. There are two reasons; the first is that the effect of lactic acid on the pH concentration is so small that it is negligible in the concentrations here concerned, and, secondly, that whatever be true as to

the action of ammonium lactate as a neutralizer or acid-former, the lactic acid in either event is progressively consumed during the process of the fermentation because lactic acid or the lactate radicle is well known to be a yeast food, not quite such a good food as sugar but a very much better food than alcohol, for example, so that the lactic acid is removed continually progressively from the fermentation, regardless of what view you take as to its acid or alkaline characteristics. So I would still defend our action in dealing with sulfuric acid alone rather than the sulfuric and lactic mixed. I think it comes closer to the action of the actual fermentations.

Q. 266. Dr. Lamb also criticised the experiments on the ground that you did not take into account phosforic acid, which might be produced from ammonium phosfate.

A. Well, I am quite sure that I recall the testimony in the early part of this trial that di-ammonium phosfate was a neutralizer. Now, if di-ammonium phosfate is a neutralizer it certainly cannot be considered as an acid former. However, even aside from that point, the same or very much the same reasoning applies to the exclusion of the phosforic acid on the ground that the phosforic acid is the chief source of phosforus for the yeast and accordingly the ammonium phosfate is used up virtually evenly, that is, the nitrogen part of it or the ammonium part of it, and the phosforus part of it, are both being used by the yeast and therefore there isn't any tendency, in my judgment, for the formation either of acid or alkali as the result of the presence of ammonium phosfate.

Q. 268. Do you know whether or not ammonium phosfate is a large item as to expense in raw materials?

A. I wouldn't like to say; I am not sufficiently familiar with the costs of these things.

Q. 270. In the Mash Sheet M177 which——

THE COURT: Just a moment, please, Doctor. Have you testified concerning what the inventor discloses in Hayduck '105?

THE WITNESS: I believe not, your Honor.

THE COURT: Line 65 to line 95?

THE WITNESS: I don't think I have.

MR. WATSON: If the Court please, this witness did not testify, was not asked about any of the patents in suit. I think I asked Mr. Philbin when he was produced and he assured me that it was not his purpose to qualify Dr. Free as a second patent expert witness on his side of the case but only to testify about certain fact experiments. He is neither a yeast manufacturer nor a patent expert, as I understand it, and I think Mr. Philbin——

MR. PHILBIN: I am not asking him, your Honor; I understood your Honor wanted to get his views.

THE WITNESS: I don't think I have testified, your Honor; I am perfectly willing to testify.

MR. WATSON: I would be very glad to have Dr. Rautenstrauch recalled for the purpose, if the Court wishes.

THE COURT: Well, the language used there is language which a chemist ordinarily would understand, is it not?

MR. WATSON: It is not addressed——

MR. PHILBIN: Would anyone understanding the English language understand that?

MR. WATSON: It is addressed to the yeast manufacturer and we have called one from the jury box before.

THE COURT: I beg pardon?

MR. WATSON: We have called one practical yeast manufacturer from the jury box already.

MR. PHILBIN: Not to testify regarding the words in the patent.

THE COURT: Well, that is not what I am asking this witness to do, to testify concerning the words of the patent. Let me state the question.

(The Court's question was repeated by the reporter as follows: "Doctor, have you testified concerning what the inventor discloses in Hayduck '105, line 65 to line 95?")

THE WITNESS: I have not testified, your Honor, but I am willing to if you wish.

THE COURT: Would you just read it over, those lines, Doctor?

THE WITNESS: I just read it through during this discussion. Do you want me to read it into the record?

THE COURT: No, just a moment.

THE WITNESS: You want me to——

THE COURT: No, just a moment, I will ask you another question in a minute. I am going to condense it.

May I ask counsel this question first: Do you think the general reading public would be called upon to understand what is meant by Balling? Do you think so?

MR. PHILBIN: No, your Honor.

THE COURT: Well, the language used in the lines that I have just mentioned contains language having a particular meaning to a chemist. Am I correct in saying that?

MR. PHILBIN: Yes, your Honor.

THE COURT: In so far as Balling measurement is concerned?

MR. PHILBIN: Yes.

THE COURT: Now I want you to feel perfectly free on either side to object to any question I ask.

MR. WATSON: I just want to express my general point of view, I have no desire whatever to restrict your Honor's questions of any witness. The patent in suit, like all patents issued, is addressed to those skilled in the art to which they pertain.

THE COURT: But the difficulty with going all the way with you on that is in this language that I read a little while ago: "The law requires the applicant for a patent right to deliver a written description of the manner and process of making and compounding his new-discovered compound. The art is new; and therefore persons cannot be presumed to be skilled in it, or to anticipate the results of chemical combinations of elements not in daily use."

MR. WATSON: I don't know what the art was in that case, if the Court please, but the yeast art, of course, is not new.

THE COURT: That means this to me, as I read it——

MR. WATSON: The yeast art is a hundred years old.

THE COURT: —that the patent in its disclosures must be so complete that at least reasonable minds would not differ as to its interpretation.

MR. WATSON: Those skilled in the art to which it is addressed.

THE COURT: It doesn't say that.

MR. WATSON: Well, I think Mr. Philbin agrees with me on that.

THE COURT: There is no one skilled in this art because this is a new thing.

MR. WATSON: That would apply to all patents. No patent is issued unless it is new; therefore there would never be a patent issued in any old art. But, of course, Mr. Philbin and I agree on that.

THE COURT: This case says very clearly "The art is new; and therefore persons cannot be presumed to be skilled in it, or to anticipate the results of chemical combinations of elements not in daily use." Let us read that also then in connection with another citation given in the same case: "The object of this is to apprise the public of what the patentee claims as his own, the courts of what they are called upon to construe, and competing manufacturers and dealers of exactly what they are bound to avoid. Grant v. Raymond, 6 Pet. 218, 247. If the description be so vague and uncertain that no one can tell, except by independent experiments, how to construct the patented device, the patent is void."

In other words, there must be enough in here and I will go along with you on the idea there must be enough in here directed to one skilled in the art——

MR. WATSON: Yes, sir.

THE COURT: —to make the compounding according to the process patent or the manufacture according to the chemical patent clear.

MR. WATSON: That is always a condition for the monopoly grant.

By THE COURT:

Q. 271. What is the process, formula, or recipe that is there given as you understand it, in your own words?

A. You take a standard——

MR. WATSON: May I express myself?

THE COURT: Yes.

MR. WATSON: I take it that your Honor is addressing the witness as a chemist?

THE COURT: As a chemist.

MR. WATSON: Because——

THE COURT: Not as a patent expert at all.

MR. WATSON: And not as a yeast maker at all.

THE COURT: And not as a yeast maker but as a chemist.

MR. WATSON: Well, then, of course, the witness' answer is bound to be immaterial, because the patent is not addressed to chemists but to yeast manufacturers.

THE COURT: What are they but chemists?

MR. WATSON: Oh, a great deal. They are not only chemists but they are experienced in the chemistry of yeast manufacture and procedure, and have qualifications in a thousand other lines than mere chemistry.

THE COURT: Well, Dr. Lamb, are you a yeast manufacturer?

MR. LAMB: No, sir.

MR. WATSON: He knows a lot about it, though.

THE COURT: We had considerable testimony from Dr. Lamb on that didn't we?

MR. WATSON: And he knows a lot about it.

By THE COURT:

Q. 272. Do you know about yeast manufacture, Doctor?

A. I believe that I do, yes, sir.

Q. 273. You have studied it?

A. Yes, sir; I have had a good deal of experience in it. I may say that my testifying in this case not as a yeast expert is not in my judgment a matter of deficiency in my qualifications but is due to entirely different personal reasons. I believe that I am competent to answer this question and to testify concerning yeast manufacture, but I have not attempted to do so in this case.

Q. 274. Would it require one versed as a manufacturer of yeast to interpret the language that I have pointed out in the specification of '105?

A. I don't think so; no, sir.

Q. 275. As you read it is that language clear to your mind as a chemist?

A. Perfectly.

Q. 276. And is it clear to your mind as one who has given study to the subject of the manufacture of yeast?

A. Certainly. I think the only——

Q. 277. Well, now, Doctor, then tell me what it means.

A. Well, I would say that it means this, that you take a standard solution, normal solution, for the manufacture of yeast, commonly known as a wort, and that has a gravity of about 12 degrees Balling. You take a part of that wort, put it in a fermenter, and dilute it to about 1 degree Balling. You thereupon seed it with yeast, add yeast to it to start it, and conduct aeration, the ordinary method of aeration used in many processes. During the progress of this aeration and the growth of the yeast, you add an additional quantity of

the original wort, 12 degree Balling, substantially continuously at a rate such that the alcohol formed can be consumed, assimilated by the yeast. It must be understood, of course, that I personally do not believe that that can be done on the basis of my former testimony, but I am discussing what is stated in the patent. That is carried out, that process of addition, aeration, and so forth, is carried out for seven to eight hours. The aeration without addition of food material, food wort, is then continued for two to three hours more, making a total of ten hours. The thing is so carried out in accordance with the last statement that the average content, the average Balling of the material in the fermenter during the process should be between 3 and 5 degrees.

Q. 278. In the fermenter?

A. In the fermenter. I can see the possibility of another interpretation of that last sentence, that that would mean—in fact, I think I heard Dr. Lamb make another interpretation one day when I was here during the very early part of the trial—that that would mean an arithmetical mean, in which you would take all the solutions used and kind of average them up together, and take an arithmetical mean of 3 to 5. I would say that that was unlikely to be the meaning in the patent because the assumption always is that the patentee, when he puts anything in the patent, is trying to disclose something of value and meaning and interest. Now, it would be of no meaning and no practical interest or value to prescribe the arithmetical mean of the solutions concerned. That is, you might have one barrel of 12 degree Balling and another barrel of 6 degree Balling, and you merely take an arithmetical mean. Whereas, of course, it is significant, quite significant, in fact, to prescribe that the Balling of the solution during the fermentation should be between certain

limits. That is, of course, well known; that if you increase that Balling during the fermentation to too high a value, like a 12 degree, for example, in the beginning, that you would get an inefficient utilization of the sugar. Personally, I think that even the 3 to 5 degree Balling is a little high, but that is evidently what the patentee specifies.

Is that what you wanted, sir?

THE COURT: Yes.

By MR. PHILBIN:

Q. 280. Dr. Lamb testified about an experiment which he made to show what he considered were the conditions in defendant's wort at the end of the sixth hour, this being shown in Plaintiff's Exhibit 21. Assuming that this is a correct showing, and disregarding any errors that may be in it, including the admitted error that there is too much phosforic acid present——

MR. WATSON: Admitted by whom, Mr. Philbin?

MR. PHILBIN: Dr. Lamb.

MR. WATSON: Did he? You haven't got that, have you?

Q. (Continuing.) —this sheet showing that there is a difference between a mash with ammonium lactate and a mash without ammonium lactate of various percentages of pH units, the greatest being 0.27, will you please comment upon that showing with respect to practical conditions and as to what difference if any the change which Dr. Lamb shows would have with respect to neutralizing deleterious acidity?

MR. WATSON: If the Court please, that is another example of the direction of rebuttal evidence through this witness. The question is asked the witness obviously as a patent expert, or in relation to practical yeast manufacture.

MR. PHILBIN: Dr. Free testified with respect to the effect of ammonium lactate in such worts as are concerned here.

MR. WATSON: I think, if you will excuse me, he testified there were certain tests which he had run with such correspondence or lack of it to defendant's processes as may be later argued. The question Mr. Philbin asked was about the practical effect in yeast processes, and I think the witness has disclaimed his knowledge of it.

MR. PHILBIN: I do not think the witness has disclaimed his knowledge of it.

THE COURT: Well, isn't it really a question that calls for a chemist's opinion?

MR. JOHNSON: If your Honor please, on page 403 of the record this witness testified "I do not pretend to be a practical yeast maker, and I have no intention of testifying concerning practical manufacture of yeast in any way."

He is asked now in effect to so testify.

THE COURT: Well, is the question one bearing upon the practical manufacture of yeast? Isn't it rather a question that comes within the sphere of a chemist?

MR. JOHNSON: Not as it was asked, your Honor.

THE COURT: Repeat the question, Mr. Heironimus.

(Question 280 repeated as follows:

"Dr. Lamb testified about an experiment which he made to show what he considered were the conditions in defendant's wort at the end of the sixth hour, this being shown in Plaintiff's Ex-

hibit 21. Assuming that this is a correct showing, and disregarding any errors that may be in it, including the admitted error that there is too much phosforic acid present, this sheet showing that there is a difference between a mash with ammonium lactate and a mash without ammonium lactate of various percentages of pH units, the greatest being 0.27, will you please comment upon that showing with respect to practical conditions and as to what difference if any the change which Dr. Lamb shows would have with respect to neutralizing deleterious acidity?")

MR. JOHNSON: Practical conditions.

THE COURT: Omit the word "practical."

MR. PHILBIN: Omit the word "practical."

Your Honor may recall that as shown on page 431 of the record Dr. Lamb was asked:

"Now, based on your study of the buffering experiments made by Dr. Free and those tests which you yourself have conducted, do you agree with the final conclusion expressed by Dr. Free" which was that about 99 per cent. of the deleterious acidity was taken care of by buffering materials and the remainder by this ammonium lactate, and Dr. Lamb replied that plaintiff's Exhibit 21 shows that the ammonium lactate took care of something like 40 per cent. of the——

THE COURT: With the elimination of the word "practical" the question, I think, comes within the sphere of the chemist and the Doctor would therefore be qualified to answer that.

A. From those figures it appears, as stated in the question, that the maximum difference in pH value between the wort without ammonium lactate and the wort

with ammonium lactate was a difference between 2.73 in one instance and 3.00 in the other instance, which would be a difference of .27 in the pH scale. It would be my judgment that that would not be a significant difference in the growing of yeast, for the reason that yeast is——

By THE COURT:

Q. 281. What would that be in percentage?

A. Well, the percentage is difficult to figure because you have no fixed basis for your percentage. If you take the lower acidity as the basis, the higher acidity in hydrogen ion concentration would be approximately 50 per cent. higher than the lower acidity in accordance with the pH scale, being a logarithmic scale.

Q. 283. In percentage what would 2.73 be?

A. That would be in the hydrogen ion concentration approximately 50 per cent.; this being a logarithmic scale, I would have to give you the anti-logarithm to give you that exactly.

THE COURT: I think that is just about what Dr. Lamb testified, did he not, that that worked out about 50 per cent.?

DR. LAMB: I beg your pardon?

THE COURT: Didn't you figure that as being about 50 per cent.?

DR. LAMB: 0.27 would nearly double; it would be almost 100 per cent. of change based on the lower figure.

MR. PHILBIN: Dr. Lamb testified, I believe, that the range of acidity which might be employed in yeast manufacture, or rather in defendant's wort as he found, was between 3.1 pH and 4.6, and in between there, of course, is this 2/10 of a per cent. found by Dr. Lamb to be caused by ammo-

nium lactate. Dr. Free's figures were that this was about 1/10; that is, Dr. Lamb found that there was about twice as much as Dr. Free found in this range between 3.1 and 4.6.

MR. JOHNSON: That is not 1/10 of per cent., Mr. Philbin.

DR. LAMB: Your Honor, may I just explain my statement to you?

THE COURT: Yes.

DR. LAMB: Actually 3.0 corresponds to 1/1000 normal concentration; 2.7 corresponds to 2/1000 normal. That is twice as great.

MR. JOHNSON: It is not per cent., Mr. Philbin, it is pH scale we are dealing with here.

MR. PHILBIN: That's right.

By MR. PHILBIN:

Q. 284. Now, will you explain what percentage it is?

A. The percentage, of course, is almost meaningless because there is no determined basis for the percentage, this being a logarithmic scale, and there not being any established zero from which you can start percentage, so that you can figure the percentage in a great many different ways. Now, really the reason for the adoption of the pH scale is the fact that the percentage does not mean much. The response of living organisms to the hydrogen ion concentration is not in general a response in accordance with the arithmetical concentration of things concerned but is a response in accordance with the geometrical concentration. That happens to be pretty generally the law of living things. So that all, nearly all mathematical expressions for things that deal with living creatures, such for example

as the decibel scale for response of the ear or the scale for response of the eye, virtually all of those scales should be on the logarithmic basis. Now, that is the reason for the pH scale; that is the reason it is a logarithmic or geometric or exponential scale, and accordingly I would like to disclaim any significance or any important significance of percentage figures. Now, the essential thing, it seems to me, is this: It is known by experiment that in the ordinary varieties of yeast with which we are dealing in this case, that the yeast will grow successfully enough over a wide, a substantial, range of pH concentration, a range perhaps between about 3.5 on the acid side and about 5.5 or thereabouts on the side away from the acid. Normally, people try to operate with these varieties of yeast, at least we do in the laboratory, at a pH value of about 4.5, but if there is a variation of say .5 either way from that, nobody worries; that is, anything between 4.0 and 5.0 is perfectly satisfactory. Now, the variation of .27 in that same scale which Dr. Lamb finds would, in my judgment, not be significant because it is not great enough to overstep the normal and ordinary range in which yeast will grow.

MR. JOHNSON: Pardon me, Doctor. Is that your judgment as a practical yeast manufacturer, or as a chemist?

THE WITNESS: I am testifying under instructions from the Court as a chemist. That is my judgment as a chemist.

MR. JOHNSON: Yes.

THE WITNESS: It would be exactly the same judgment if I were testifying as a practical yeast manufacturer.

A. (Continuing.) I was just about to say that perhaps I might explain that the discrepancy between ap-

proximately .1, which we got in this experiment and approximately .3, which Dr. Lamb got, is due, in my judgment, to the fact that we were operating over different pH ranges. Dr. Lamb has assumed, as was testified previously, that the phosforic acid and lactic acid also would be present in the wort at that time. We did not believe that and did not assume it, and accordingly the range of this whole scale over which we were working was a little different. I have no disagreement whatsoever with the figures in Dr. Lamb's statement as given in this document.

MR. PHILBIN: I said in my question, I believe, that Dr. Free obtained .1 per cent. and Dr. Lamb .27 per cent. I should have said that it was not percentage but was .1 of a pH unit, and .27 of a pH unit.

That is all.

CROSS-EXAMINATION BY MR. WATSON:

XQ. 285. Regardless of the basis of the pH scale or the reason why the pH scale is logarithmetic, it is a fact, is it not, that 2 thousandths normal sulfuric is twice as strong as 1 thousandth?

A. Well, it depends somewhat on circumstances; but in general that is correct. You couldn't make a complete statement to that effect, because it would depend upon the ionization, and that in turn would depend upon temperature and other things; but I have no quarrel with the statement as a practical matter.

XQ. 286. Is it a fact that under the same general conditions 2 thousandths normal sulfuric would have twice the hydrogen ion concentration as 1 thousandth normal would have?

A. Well, I am not quite sure that I—you say 2 thousandths normal? Of course, 2 thousandths normal is weaker than 1 thousandth normal, but I think—I can

clarify it very quickly: If on the scale, in the scale of normality, one sample of acid is twice another sample of acid, it will in general have twice as much hydrogen ion concentration, twice as great hydrogen ion concentration. I think we may have gotten a little mixed up there about the thousandth and 2 thousandths—that is, whether you mean 2 one-thousandths or 1 two-thousanths.

XQ. 287. Is 2 thousandths normal hydrogen ion twice 1 thousandth normal hydrogen ion?

A. That is, 2 one-thousandths——

XQ. 288. Correct.

A. (Continuing.) —is twice 1 one-thousandth. In general that is a reasonable statement.

XQ. 289. What is the formula of di-ammonium phosfate?

A. NH_4 taken twice, HPO_4.

XQ. 290. What was the content of the non-fermentable sugar in the worts of your experiments 14 and 15 at hourly intervals?

A. That could be computed only from the data——

XQ. 291. I am asking you what it was.

A. I don't know except by referring to my data.

XQ. 292. Does your data include that figure?

A. It can be computed from the data; yes, sir. I do not think that the data indicate it directly.

XQ. 293. Did you in those tests make any analyses for non-fermentable sugars as distinguished from fermentable sugars?

A. We made determinations of reducing sugar at the end of the test, when the fermentable sugar was gone. That gives a datum from which the rest can be calculated. Some separate tests have been made on the percentage of non-fermentable sugar in the molasses.

XQ. 294. What was the content of the fermentable sugar at the end of the tests?

A. If you will get me my data book, I will be glad to give it to you for any individual——

XQ. 295. I had understood from your testimony yesterday afternoon that there was no fermentable sugar at the end of that test.

A. I beg your pardon, I thought I understood you to say non-fermentable sugar.

XQ. 296. I am talking about the non-fermentable as distinguished from the fermentable.

A. At the end of the tests, or at least most of them, there was no fermentable sugar left. The non-fermentable sugar or reducing substances left will be given by the data.

XQ. 297. At the end of the test did you make an analysis to determine the fermentable sugar?

A. In general, no. Such tests have been made in individual instances.

XQ. 298. In those tests, then you assumed that what you found as sugar at the end was a non-fermentable sugar?

A. Yes, sir.

XQ. 299. And the calibration or the computation that you speak of for finding the non-fermentable sugar at hourly periods would depend upon that same assumption?

A. Certainly.

XQ. 300. Was there any difference between your tests 5 and 6 on the one hand and your tests 14 and 15 on the other, beyond the difference which you have already stated, that in 5 and 6 you failed to test for yeast yield at the end of the eighth hour?

A. As I recall it, there was no essential difference. However, there may have been minor differences. For that, of course, we would have to refer to the data.

XQ. 301. What is the highest yield of good quality bakers' yeast on sugar that has been secured in

practice, either commercial or experimental, within your knowledge?

A. You mean on pure sugar?

XQ. 302. I mean on the fermentable sugar in worts used commercially.

A. Well, I must ask you whether you mean sugar worts or molasses worts, because there is an essential difference.

XQ. 303. All right. Let's have it first on molasses wort.

A. Figuring it on the fermentable sugar in the molasses, I would say that the highest commercial yield that I know about is approximately 180 or 185 per cent. That cannot be, in my judgment, sustained regularly. In the laboratory it is possible to obtain yields as high as 205, and 215 per cent. That is using beet molasses, with all the conditions satisfactory, and the yield being figured on the percentage of fermentable sugar in the molasses.

The per cent. of fermentable sugar in the molasses will vary to some extent in different samples of molasses. In molasses that I was assuming in answering the question where I said the yield was 185 per cent. it was from 45 to 50 per cent. of fermentable sugar in the molasses.

XQ. 306. Well, that would alter the yield percentage figure quite greatly, if you took 45 in one case and 50 in the other.

A. Well, of course, in any individual instance you naturally take that into account. That is, you know what the molasses is with which you are working. You know what its percentage of fermentable sugar is.

XQ. 307. I am asking what the fermentable sugar was in the molasses of which you said the yield was 185 per cent.

A. I didn't say anything about that. That is, you would in each case figure your yield.

XQ. 308. Now, I am asking you; I am asking you.

A. You want a specific example of—you asked me in general what did I know about it. Now, if you want a specific example, we performed one experiment in which the percentage of fermentable sugar in the molasses was 47.8 per cent., and the yield on that experiment was 193 per cent., on that fermentable sugar. But as I understood your previous question you wanted to know in general what I considered to be the commercial yields rather than the laboratory yields.

XQ. 309. What are the chief substances present in the solution of molasses?

A. Well, to answer that completely would take, I suppose, about a week.

XQ. 310. Well, let's confine it to yeast nutrient substances.

A. The most important yeast nutrient substance in ordinary molasses is sugar, partly present as sucrose and partly present in most instances as some other form of sugar. Next to that there are some nitrogenous substances present of very complicated character. There is some phosforus present, there is some sulphur present, which may be a yeast nutrient, there is some potassium present, and in beet molasses especially there are present substances of unknown nature, which are apparently essential to yeast growth in a similar fashion to the vitamins for animal growth.

XQ. 311. In your blank runs to test how much alcohol was evaporated, did you intend to duplicate the conditions of defendant's operations shown in Plaintiff's Exhibits 13, 14 and 15?

A. No, sir; those blanks were intended to duplicate the experiments made with and without alcohol, which were not exactly the same as the defendant's operation.

XQ. 312. When a solid is dissolved in a liquid, what is the effect on the boiling point of the liquid?

A. In general the boiling point of the liquid would be raised, but I wouldn't want to say that there were no exceptions to that rule.

XQ. 313. Is that because the vapor pressure is lowered?

A. I wouldn't say that it was because the vapor pressure was lowered, it is because of atomic associations in the liquid, which may affect both the boiling point and the vapor pressure.

XQ. 314. Is the vapor pressure lower when the solid is dissolved in the liquid?

A. Usually so. I again would not wish to say that there were no exceptions.

XQ. 315. Well, let's take such solids as your have spoken of as in molasses.

A. In general, the effect would be to lower the vapor pressure of the water in the solution, which I suppose is what you mean.

XQ. 316. Now, what is Raoult's Law?

A. It is a law which deals with the vapor pressure relations of different mixed substances.

XQ. 317. That is what it is about. I am asking you what it is.

A. It is a law which says essentially that the vapor pressure relations, other things equal, will be proportional to the molar concentrations of the substances present.

XQ. 318. That is a well recognized and inflexible law, is it not?

A. It is not inflexible, it is well recognized.

XQ. 319. Well, it is a well recognized law?

A. But it is not an inflexible law.

XQ. 320. But well recognized?

A. Well recognized as not being inflexible. I may say without fencing that I am entirely in agreement

with Dr. Lamb's method of calculating vapor pressure in this case, as I understand it. No argument about that that I know of.

XQ. 321. In your buffering experiments you said that you chose conditions to represent the over-all status of the process because the calculation on the over-all basis represented in your opinion the maximum acidity danger. What you said was that it represented the maximum danger according to your calculations. What did you mean by "your calculations"?

A. It represented the maximum danger in our judgment due to sulfuric acid produced from the ammonium sulfate; that is, our assumption was that the ammonium sulfate might be entirely converted into sulfuric acid. That would probably not actually happen, in fact; but we made that assumption. Then we studied the process as disclosed in the defendant's answer and came to the conclusion that the maximum amount of sulfuric acid released would be at the end of the yeast propagation and also that that would be the time of maximum concentration of that sulfuric acid. Now, in order to allow for some possible inaccuracy of those figures, because of certain uncertainties, some uncertainties concerning the addition of ammonium sulfate and the utilization of ammonium sulfate, we made a check with an increased dilution which would take account in our judgment of anything of that kind.

In general an acidity on the pH scale, which is tolerable and desirable, toward the end of the yeast propagation process is tolerable and desirable at an earlier stage of the process during rapid propagation, as long as the acidity is not too widely varied from the normal.

The yeast during an earlier period of its rapid propagation will tolerate as high a pH acidity as at the

end of the process. Incidentally, of course, the period of rapid propagation is not at the beginning of the process.

By "beginning" I mean when you begin the propagation of yeast.

XQ. 325. Over how long a period of the propagation do you include in the "beginning"?

A. Well, perhaps I had better explain it.

XQ. 326. All right.

A. When the yeast is first seeded into a new solution there is in general a latent period of relatively slow propagation.

XQ. 327. Well, you will excuse me for the interruption, but first answer my question, please.

A. Well, I am afraid I must make an explanation.

XQ. 328. Well, you can do it afterwards, Dr. Free.

A. If you will state the question I will see whether I can answer it.

XQ. 329. What period do you include in the term "beginning" in your prior answer?

A. The period up until the cessation of feed.

(Interruption.)

A. (Continuing.) The answer was uncompleted at the time of the interruption. Suppose you read the answer again.

(Answer repeated by the reporter as follows: "A. The period up until the cessation of feed.")

A. (Continuing.) That need have nothing added to it except to point out that by "beginning," of course I am using "beginning" in the sense in which I originally used it—the meaning is this, that the maximum propagation of the yeast is approximately at the same time as the end of feed of sugar under normal conditions. Up to that time the propagation of the yeast has been at an increasing rate, not uniformly increasing rate but a rate generally increasing.

XQ. 330. Is it not a fact that after the end of the sugar feed the yeast can well tolerate higher acidities than during the active propagation while the feed is continuing?

A. In my judgment that would not be true, until after the propagation of the yeast has ceased, which is not necessarily at the same time, at the end of the sugar feed.

XQ. 331. Is it not true, so far as you know and in any event do you not believe that the yeast during active propagation is more susceptaible to overacidity dangers than at the end of the process after the feed has ceased?

A. I don't think so.

There are other phosforus sources than ammonium phosfate in the mash material. In the mash materials which we have been discussing in this case there are. In the molasses and the grain material also, in cases where that has been employed.

XQ. 334. Have you read the opinions of the Court in the litigations on any of these patents?

A. You mean this Court?

XQ. 335. The opinions of the Federal courts in Maryland.

A. No, sir, I have not. I have glanced through them but I have not read them with any care.

XQ. 336. You justified your omission of phosforic acid from your buffering experiments on the ground, as I recall it, that the nitrogen and the phosforus of the ammonium phosfate would be simultaneously or equally taken so that there would be no phosforic acid released. You were referring, I presume, to the ammonium phosfate that you had mentioned in an earlier answer, namely, di-ammonium phosfate?

A. It would be true of either di-ammonium or mono-ammonium phosfate, approximately true; it

wouldn't be perhaps exactly true and that would depend also upon the other quantities of ammonia or nitrogen present in the wort. I would say that it would be approximately true of all of the worts concerned in the defendant's answer to interrogatories, whether or not these contained di-ammonium phosfate or mono-ammonium phosfate.

XQ. 337. You expressed the opinion that Dr. Lamb had erred in the conditions of the test shown on Plaintiff's Exhibit 21 in other respects, as I recall, because you thought Dr. Lamb had used di-ammonium phosfate or made a calculation on the basis of di-ammonium phosfate; is that correct?

A. I don't think so, sir; no. I didn't say that Dr. Lamb had erred. I think I did point out that there was a difference in my judgment as to the basis of this experiment, but that difference did not involve di-ammonium phosfate in this case, it involved merely the addition of phosforic acid to the tested wort, which I didn't think was justifiable. It wouldn't make any difference whether that phosforic acid came from di-ammonium phosfate or mono-ammonium phosfate.

XQ. 338. On page 529 you were asked: "Dr. Lamb also criticized the experiments on the ground that you did not take into account phosforic acid. What have you to say as to that?

"A. Well, I am quite sure that I recall the testimony in the early part of this trial that di-ammonium phosfate was a neutralizer. Now, if di-ammonium phosfate is a neutralizer it certainly cannot be considered as an acid former" and so forth. You were expressing the opinion there, were you not, that Dr. Lamb's criticism was incorrect?

A. No, I wasn't in that part of the answer. In the subsequent part of the answer I was pointing out my objection to his experiments in the inclusion of the phosforic acid.

XQ. 338. In that answer why did you mention or make any mention of di-ammonium phosfate?

A. I didn't make any except in the first part of it, at least I don't think I did.

XQ. 339. Well, why did you make it in the first part?

A. Because it was my recollection that it had been stated in the testimony I heard that di-ammonium phosfate was a neutralizer. Now, if that was not stated, why, of course, I am glad to withdraw that remark.

XQ. 340. Do you know whether any di-ammonium phosfate was used in defendant's operation as shown by the mash sheet Plaintiff's Exhibit 14?

A. I believe that it was but I would like to see the exhibit before I say definitely yes or no.

XQ. 341. Was your testimony there based on the assumption that the Plaintiff's Exhibit 14 showed that defendant had used in that operation di-ammonium phosfate?

A. No, sir; it was based upon the assumption that di-ammonium phosphate had been used at some times during the process concerned.

XQ. 342-3. Did you know which of defendant's runs Dr. Lamb's test, shown by the exhibit, was intended to correspond to?

A. I assumed that it corresponded to the general process described in the defendant's answer to the interrogatories.

MR. PHILBIN: For the possible benefit of the——

XQ. 344. I will ask you if you find in Plaintiff's Exhibit 14——

MR. WATSON: Excuse me a second, Mr. Philbin.

MR. PHILBIN: Dr. Lamb testified on page 116 of the record: "In addition I might point out that

in the last mentioned operations for December the 7th to 9th, 1932, some di-ammonium phosfate was added at intervals to the propagating vats during the growth of the yeast and this substance too exerted some neutralizing action. (Tr. 116.)

MR. WATSON: Which testimony referred to Plaintiff's Exhibit 15, and which is an accurate statement of plaintiff's position with respect to defendant's operations shown by those mash sheets, but which also has no relation to the specific conditions of the test shown in Plaintiff's Exhibit 21, which Dr. Free criticized.

XQ. 345. I show you the mash sheet M-177 and ask you if it discloses the use of any di-ammonium phosfate?

A. Well, I am sorry, I am afraid it would take some time to study this and perhaps I——

XQ. 346. Aren't you familiar with those processes?

A. No, I am not.

XQ. 347. Can you read a mash sheet?

A. Certainly. But I can't read it in thirty seconds.

AFTER RECESS.

During the intermission I have examined the mash sheet so that I can now answer.

XQ. 351. Please answer the prior question (XQ. 345), whether it shows the use of di-ammonium phosfate.

A. It discloses among the named materials the use of ammonium phosfate, which is not specified as to whether it is di-ammonium or mono-ammonium phosfate.

XQ. 352. Do you know whether, in fact, that ammonium was di-ammonium or mono-ammonium?

A. You mean the ammonium phosfate?

XQ. 353. Yes.

A. I do not, no, sir.

Mr. Johnson: Your Honor please, the defendant's answers to the interrogatories show that the material designated in the flow sheets with the large letter A is ammonium acid phosfate, the letter D having later been used to designate the material di-ammonium phosfate, and the letter A is the only one that appears on these flow sheets in Plaintiff's Exhibit 14.

XQ. 354. In your direct examination you also justified your omission of lactic acid and expressed the opinion that Dr. Lamb's criticism of your experiment on that account was an unsound one, did you not?

A. I believe so, yes, sir.

XQ. 355. Your testimony on that appears at record pages 528 and 529, does it not?

A. I believe so. In all of my testimony on that point I was referring to lactic acid possibly formed from ammonium lactate. In giving that testimony I was reasonably familiar with the defendant's operations shown on Plaintiff's Exhibit 14. However, our basis of carrying out these tests was not the mash sheets but was the written answer to interrogatories in which the defendant had set forth the general process.

XQ. 358. Were you familiar with the fact that defendant's operations as shown by the mash sheets and as stated in its answers to interrogatories included the over-souring of the mash materials to provide an excess of free lactic acid?

A. I wouldn't express it that way. The question of over-souring or under-souring is a matter of judgment and the reason——

XQ. 359. I will amend the question by asking you whether you were aware that in defendant's operation

as shown by those mash sheets and as described in its answers to our interrogatories the defendant did use a nutrient solution containing free lactic acid?

A. Yes, sir, there would be some free lactic acid in the soured mash.

XQ. 360. Did you in your tests provide the presence of lactic acid in corresponding amount?

A. No, sir, that would be a negligible quantity.

XQ. 361. In your testimony on page 528 you were asked what you had to say on Dr. Lamb's statement that you failed to take into account the presence of lactic acid and your answer reads: "Well, I suppose that what Dr. Lamb had in mind was the lactic acid which might conceivably be produced in the fermenter by the decomposition of ammonium lactate." On what did you base that assumption or supposition?

A. On my hearing of the testimony.

XQ. 362. You had not read the testimony then in making that answer?

A. I had heard it but not read it, no, sir.

XQ. 363. In your experiments 14 and 15 what were the dimensions of the vessel you took as representing the fermenter?

A. I believe I testified before that it was approximately 2 feet in diameter by approximately 2 feet high, but those are only approximate figures. The capacity was in the neighborhood of 130 or 140 liters. The depth of the liquid varied from I should say approximately 15 inches in the beginning to perhaps 20 inches or so at the end. Those figures can be supplied exactly if you wish them, but I don't have them in my head.

In those tests I did not provide percentages of alcohol corresponding to the percentages of alcohol in defendant's commercial practice as shown in Plaintiff's Exhibits 13, 14 and 15. I had no information concerning the amounts of alcohol in defendant's commercial practice.

XQ. 366. So therefore I may take it, may I, that in your blank tests on alcohol loss by evaporation the amount of alcohol you used in the test did not purport to represent the amount present in defendant's commercial operations as shown in Exhibits 13, 14 and 15?

A. That is correct, sir.

I have only studied the defendant's manufacturing processes as set forth in the answer to the interrogatories, not otherwise. I have only studied plaintiff's manufacturing processes from what I might call a strictly external point of view. I claim no detailed knowledge of them. I never studied the yeast manufacturing processes of the Federal Yeast Corporation. I have only studied the yeast manufacturing processes of other manufacturers of bakers' yeast in the United States incidentally as bakers' yeast was manufactured by some of our clients who were in other businesses primarily.

XQ. 371. If you can give me the information without a breach of confidence, can you tell me the name of the company you have in mind?

A. I would prefer not to because the matters involved were controversial and confidential. I can say this, however—;—

XQ. 372. What date was that?

A. Approximately 1920.

XQ. 374. Is the company still making bakers' yeast and selling it commercially?

A. Not to my knowledge.

It was doing so at that time; I cannot say on how large a scale. It was in the bakers' yeast manufacturing business up to that time approximately twenty years.

XQ. 378. How long afterwards, after you consulted with it, did it remain in the yeast manufacturing business?

A. My understanding is approximately ten years, but I am not certain about that.

In that process the mash materials the company used was grain.

XQ. 380. Was it a straight set operation?

A. Not essentially, mostly, a straight set operation, but not entirely so. I may say that this particular manufacturer I am talking about was a manufacturer of yeast incidentally to the manufacture of beer, which, of course, was, perhaps still is, a common procedure.

XQ. 381. Manufacture of bakers' yeast?

A. Yes; yeast for use by bakers. Sold for that purpose—to my understanding; I had nothing to do with the sales.

XQ. 383. You say the company was also a manufacturer of beer. Can you tell us whether it manufactured the beer and manufactured bakers' yeast in the same fermentation process?

A. Partly so, yes; not entirely so.

XQ. 384. Just what do you mean by partly? Explain that, please.

A. The company manufactured yeast as a by-product of the manufacture of beer in the same fermenters, and also on occasion manufactured yeast from which the beer was not saved. So that both were involved.

XQ. 385. You mean the company harvested the yeast which had been used to ferment the mash materials to make beer, and then compressed and sold that yeast to bakers?

A. The yeast, it is my recollection, was not pressed, but it was sold. I won't be certain about the details, but that is my recollection.

XQ. 386. And what was the extent of your study of that company's yeast manufacturing operations at that time?

A. What do you mean by extent? That is, how much time did I spend on it? I inspected its operations. It is very difficult to say after this passage of time how long a time I spent in the plant, observing it. I should say perhaps a week.

I do not know what Balling the company used in the fermenters at the start. I may say, if this is important, I can try to find our notes on the work, but it is all very long ago.

XQ. 390. Never mind. Then I am to understand that the experience which you have given us is the extent of your actual familiarity with the commercial manufacture of bakers' yeast in this country?

A. No, sir, I wouldn't say that. I, of course, have studied the literature.

XQ. 391. I understand that, Dr. Free, but I am asking about direct first-hand observation and knowledge of yeast manufacturing processes as carried on commercially by companies engaged in the business in this country.

A. It is the extent of direct first-hand contact except contact with the operations of the National Grain Yeast Corporation.

XQ. 392. From what you have just told me, I thought that you had no knowledge of the defendant's commercial operations, that is, you had not observed them.

A. No, I didn't say I had no knowledge, I didn't have complete knowledge; at least, that is what I intended to say.

XQ. 393. Did you mean to express the opinion that the figures used by Dr. Lamb were not in correct correspondence with the concentration at the end of the sixth hour by his calculation which corresponded to the method of calculation used by you in arriving at the concentration you chose as representing the end of the operation?

A. You were referring to Exhibit 21?

XQ. 394. That's right.

A. No, I haven't expressed such an opinion because I have not studied——

XQ. 395. I thought not, but I just wanted to make sure.

A. —in detail this method of calculation.

XQ. 396. From your knowledge of defendant's operations, so far as you have it, do you agree that about 1 degree Balling is a desirable concentration in the fermenter during the propagation for the efficient utilization of the nutrients toward maximum yeast production and minimum alcohol production?

A. I don't have a sufficient knowledge of the details of the defendant's production to answer that question with that preamble; I am willing to answer the question in general but it would be unfair to the defendant for me to pretend any accurate knowledge of the Balling of the defendant's operations.

XQ. 397. Well, I will show you the Ballings, they are in evidence already. I show you the mash sheet M177 and under the second column of the Balling readings—of course in considering those you may make an appropriate deduction over the period for the Balling rise attributable to growing yeast and yeast in suspension.

A. Well, now, what did you want to ask me about these?

I agree that about 1 degree Balling is the desirable concentration in the fermenter during the propagating period for efficient utilization of the nutrients toward maximum yeast production and minimum alcohol production, assuming that that 1 degree Balling represents substantially the sugar concentration, percentage of fermentable sugar. I don't wish to make any comment on the defendant's process but in general I agree that about 1 degree of Balling representing sugar concen-

tration, that is, about 1 per cent. of fermentable sugar, is a satisfactory condition.

XQ. 399. At the conclusion of your answer to Q. 277 on page 536 of the record you said: "The thing is so carried out . . . that the average content . . . in the fermenter during the process should be between 3 and 5 degrees." What did you mean by "the thing"?

A. The process which I was discussing—is so carried out.

The factors included in that process which I had discussed are stated, I believe, previously in the answer. This was a discussion of certain paragraphs from the Hayduck patent. One of those factors was starting the yeast propagation in a portion of the nutrient solution, diluted to approximately 1 degree Balling.

XQ. 405. And another factor referred to by you was adding the more concentrated reserve at a rate such that the alcohol formed can be consumed, was it not?

A. I was quoting from the patent, yes, sir.

XQ. 406. Another factor was aeration?

A. I am not sure that I mentioned that but that is a factor, yes, sir.

XQ. 407. If you start with a nutrient solution in the fermenter of about 1 degree Balling and proceed from that time on and in such a way that the Balling in the fermenter during the propagating process averages between 3 and 5, how will you accomplish that result?

A. By feeding in the additional wort of specific gravity 12 Balling, in sufficient quantity, total quantity, so that your final average concentration in the fermenter would be somewhere between 3 and 5 degrees, diluting, if necessary, in order to keep that range.

XQ. 408. That is the factor referred to in your answer, which is the controlling factor in arriving at

that average of 3 to 5 in the fermenter during the process?

A. Well, I should say it was the most important factor. Of course, other factors would be involved: The consumption of material by the yeast, the growth of the yeast itself, and so on.

XQ. 409. But those factors, such as growth of the yeast that you have referred to, indeed that is the only one you have referred to—that would act in the direction of reducing the Balling, would it not?

A. The growth of the yeast?

XQ. 410. Yes.

A. No; the growth of the yeast itself would increase the Balling. The assimilation of food by the yeast would tend to reduce the Balling.

XQ. 412. In order that we may understand the opinion you expressed on that portion of the Hayduck Patent '105, will you please indicate on a sheet, which I hand you, the Balling curve during the ten-hour process, to represent the average Balling in the fermenter, during the operation, of between 3 and 5 degrees?

A. I must decline to do that without consideration. Furthermore, I wish——

XQ. 413. You may have all the consideration you wish.

A. Well, I can't. I must have several hours' time to study that. I must add, of course, that I am not claiming that this can be done. I was merely interpreting certain statements pointed out to me by the Court in the patent. Now, it is quite probable that it won't work, I don't know. I would be very glad to make up such a chart, or try to, but I must have a half day or so to study it. Of course, also, I wish to state that I am not testifying as a person familiar with these patents. I haven't studied these patents. I have read them but I don't know very much about them, and I don't want to pretend an expert opinion of them.

MR. WATSON: If the Court please, I think the witness is manifesting a very different attitude from what he did under prior examination on that point, and I will have to ask him to take time to draw that curve.

THE WITNESS: Well, then, I must ask an adjournment, your Honor, if you wish me to do that.

THE COURT: Very well.

MR. WATSON: All right. I have some other questions, however.

THE WITNESS: Of course, I would like to state for the record that I do not recognize any different attitude on my part. I will be very glad to answer any question within my competence, but I have not pretended to understand these patents.

THE COURT: I haven't noticed a different attitude, Mr. Watson.

MR. WATSON: What is that, sir?

THE COURT: I haven't noticed any different attitude.

MR. WATSON: Well, if the Court please, the witness now says that he explained a sentence in the patent to mean something which he thinks may be inoperative. Now, I certainly didn't get the impression from his——

THE COURT: That has no bearing upon the witness' change of position. He wasn't taking a position that it could or it could not be done. He was simply asked what does this mean. He reads English the same as you do, the same as I do, and he reads it and he says it means thus and so. The experts on the other side have read it and come to a different conclusion.

MR. WATSON: That is perfectly true, your Honor.

THE COURT: Now, wherein he has changed his position I fail to see. He simply is called upon here, perhaps out of order, by the Court to give his opinion for what it is worth as to how he reads that formula or that direction, and he reads it one way, Dr. Lamb reads it another way; finally it will be for me to read.

MR. WATSON: That is correct.

XQ. 414. I will ask you some more questions on that, Dr. Free.

THE COURT: Well, it may be helpful, I don't know, to show what that curve is, but it doesn't make a particle of difference as I see it at the present moment. I am concerned with the language of the specification read in connection with the claims.

MR. WATSON: I am going to ask some questions on that language, yes, sir.

XQ. 415. Starting the propagation in the fermenter with a nutrient solution of 1 degree Balling, can you raise the Balling within the range of 3 to 5 during any substantial part of the propagating process in any other way than feeding in more concentrated yeast nutrients to the fermenter during the period.

A. I don't know——I think it probably cannot.

XQ. 416. If it is raised, let me ask you this question——

THE COURT: If it is raised it would have to be raised by increasing the Balling somehow, wouldn't it?

THE WITNESS: Certainly.

XQ. 416: (Continuing.) Let me ask you this question: In your opinion, does the Hayduck patent in the sentence that you explained suggest any other means of raising the Balling from 1 degree at the start to within the range of 3 to 5 during the process?

A. I do not recall any. The patent, from my recollection of it, is not perfectly clear, but I recall no such statement in it.

XQ. 417. Then assuming that we take an operation in which the yeast propagation is begun in a portion of the solution diluted to 1 degree Balling and we feed in more concentrated 12 degree solution at such a rate that the Balling in the fermenter rises to say 4 degrees Balling, in the middle of the 3 to 5 range, and feed thereafter is maintained so that the Balling remains at that point for a considerable period, does that mean that during the period of our addition, changing the Balling from 1 degree to 4 degrees, we feed at such a rate that the yeast can assimilate most efficiently the nutrients with the maximum production of yeast and minimum production of alcohol?

A. That will depend entirely upon the source of the Balling in the 12 degree wort.

XQ. 418. Let us confine ourselves to molasses or grain wort of 12 degree Balling.

A. If you have——

XQ. 419. Of which the art was well aware at that date.

A. If you had a molasses or grain wort which contained a substantial quantity of non-fermentable material so that Balling was due largely to something that wasn't being fermented rather than to things that could be used, then you would have a very different condition from the condition in which you were feeding, for example, pure sugar solution.

XQ. 420. Let's take any mash materials that were in commercial use in yeast manufacturing in 1915 and

let us take a solution of those of 12 degrees Balling. Now can you answer the question.

A. Let me have the question.

XQ. 421. A wort of normal composition.

(Question repeated by the reporter as follows: "Let's take any mash materials that were in commercial use in yeast manufacturing in 1915 and let us take a solution of those of 12 degrees Balling. Now can you answer the question?")

A. It is the former question is the one I want.

XQ. 422. I will supplement my question with asking you under those conditions do you know if the reserve could be fed in at a rate so that the Balling in the fermenter originally at 1 was raised to 4 and maintained at the latter figure over a substantial part of the propagation. During that period that the feed was elevating the Balling from 1 to 4, would the yeast be able most efficiently to assimilate the nutrient being added toward maximum yeast production and minimum alcohol production?

A. I would say that it was possible, yes.

XQ. 423. And over the continuing period while the feed is at a rate such that the 4 degree Balling is maintained, is it your opinion that the feed would be at a rate such that the yeast could most efficiently assimilate the assimilable nutrient of the solution toward maximum yeast production and minimum alcohol production?

A. Well, I would answer yes but I would add that, of course, I haven't assumed and I don't read the patent as contemplating the idea that the Balling should be raised suddenly to 4 degrees and then that 4 degrees should be maintained. I may be wrong but my interpretation of the patent is that it is raised to a point, not specified, such that the average or mean Balling

during the whole fermentation should be between these limits.

XQ. 424. Well, you mean that it may raise the Balling to we will say 8 degrees at the end of the process?

A. In the meaning of the patent, certainly; I am not implying that I think it would be a good idea but I am merely attempting to interpret the patent as to what I think would be covered by this sentence which the Court asked me about.

XQ. 425. Then suppose that we took a process where propagation was initiated in a solution of 1 degree Balling and fed it 12 degrees Balling at such a rate that the Balling curve rose on a straight line over the propagating period to the end of the feed, at which time the Balling was 8; in other words, I am stating the conditions of my prior question which you said you thought were within the disclosure of the patent. In such an operation is it your opinion that the feed would be at a rate where the yeast could assimilate the assimilable nutrient most efficiently toward maximum yeast production and minimum alcohol production?

THE COURT: As known in 1915.

XQ. 426. As known in 1915 or before or since.

THE COURT: What bearing would it have on it since?

MR. WATSON: Well, the answer will be the same. That is the reason I say it but I am asking for 1915.

A. I would hesitate to commit myself as to 1915 because I haven't looked up with sufficient completeness the kinds of worts that might be available. If we assume that the worts in 1915 were substantially similar to those today, which I suppose perhaps would be true, then my answer to your question would be no, it is not my opinion that that would be most efficient operation.

XQ. 427. Let's take an all-grain wort as of 1915.

A. With an all-grain wort it would be possible although unlikely; that is, if you had an all-grain wort which contained a large percentage of non-assimilable materials you might conceivably get that result which the patent calls for.

XQ. 428. I mean, of course, 1915, grain wort of the type which would have been normally used by a yeast maker of that date, if he selected a grain wort to carry out commercial operations. Is your answer still the same?

A. I would not expect it to give a satisfactory result, but of course I must specify that I am testifying on these points without having at all refreshed my memory in this matter. Accordingly, I don't want my statements to be taken too seriously.

XQ. 428a. You say "not expected to give a satisfactory result." My question is whether you think it would give a result toward alcohol production in substantial amount.

A. That is, would it or would it not give alcohol production?

XQ. 429. In substantial amount.

A. That would depend entirely on other circumstances. If you phrase the question as you did before, would this give a satisfactory, or I forget your wording, would this give a result embodying the most efficient utilization of sugar and the least production of alcohol —

XQ. 430. Yes.

A. —my answer is no. In my judgment, qualifying my judgment by the fact that I don't know enough about it to have any really thorough judgment of it.

XQ. 431. If one expressed the opinion that the meaning of the sentence in the Hayduck '105 patent under consideration was that the operator would start

with a Balling in the fermenter of 1 and feed it in so that the Balling would rise within a range of 3 to 5 and remain in that range over a major period of the propagating period, am I to understand that that opinion differs from the opinion that you have just expressed of the meaning of that language?

A. That would be another alternative meaning which might come under this language provided the average of the Balling over the whole period lay within this limit here, and that of course would be the case if you reached reasonably soon after beginning the propagation a Balling of 4 to 5 degrees and then continued at that point. I mean by "average" in my answer, the average concentration in Balling of the material in the fermenter; that is, if you took the Balling every minute during the entire fermentation and averaged those values, I would say that the patentee in this case intended that that average should lie betwen 3 and 5 degrees.

XQ. 433. You stated, record page 536, that the language of the patent in this respect, if interpreted as you understood it had been interpreted by Dr. Lamb "would be of no meaning and no practical interest or value," "interest" meaning value to whom?

A. To a person attempting to repeat the process. To a skilled yeast manufacturing operator.

XQ. 435. There is evidence of record that the defendant herein in the three types of its process——

THE COURT: Just a moment, three types of its process; I don't just know what you mean by that.

XQ. 435. (Continuing.) —in its processes as shown by the three mash sheet records, Plaintiff's Exhibits 13, 14 and 15, divided the concentrated wort so that the fraction placed in the fermenter at the start and diluted to about 1 degree Balling was chosen to give a calculated mean Balling between the diluted portion

in the fermenter at the start and the Ballings of the reserve later to be fed within the range of 3 to 5 degrees. It is also of record that the Federal Yeast Company in its process enjoined under the patent '105, divided a concentrated wort so that the portion in the fermenter when diluted calculated with the balance to be later fed in at a mean Balling of 4 degrees. In your opinion, is that merely a fortuituous circumstance?

A. I have no idea, I have no information concerning why either of these processes were worked in that way.

XQ. 436. You expressed the opinion, which we have just reviewed, that Hayduck's rule, if interpreted, to select the fraction for dilution to begin propagation in, if that rule meant that the diluted part in the fermenter at the start, calculated with the more concentrated reserve to be fed in, had a mean Balling of 4, that such a rule would be of no practical value to the yeast manufacturer?

A. Yes, sir.

XQ. 437. I am asking you now whether you think that defendant's selection in that respect had practical value in its process.

A. No, sir.

XQ. 438. And I assume, therefore, that you think that the Federal Yeast Corporation's such selection was without value.

A. On the assumption stated, yes. I know absolutely nothing about the operations of that company.

THE COURT: Will Dr. Rautenstrauch be here here again?

MR. PHILBIN: We had not expected to call him, your Honor, but we would be very glad to produce him.

THE COURT: Was he here when Dr. Lamb made the experiment?

MR. WATSON: The demonstration—I think he was. If your Honor has any questions Mr. Philbin could doubtless ask him to be here.

THE COURT: After the testimony is all in after you are all through I would like to ask him a question or two possibly.

MR. PHILBIN: We will be very glad, your Honor, to have him here at the next session of this court.

THE COURT: Then, if he comes, give him preference so he can get away.

MR. PHILBIN: Yes, your Honor.

MR. JOHNSON: Your Honor please, your Honor mentioned experiments yesterday in connection with that rule. I simply wanted to leave this thought: that these things done here were not experiments.

THE COURT: What I am concerned with is whether or not the mathematical calculations, for one thing——

MR. JOHNSON: They were mathematical calculations—demonstrations to show that the mathematical calculations were correct.

THE COURT: The thing that concerns me is this: whether or not that mathematical calculation falls within what the United States Supreme Court had in mind when it said: "If the description be so vague and uncertain that no one can tell except by independent experiment how to construct the patented device the patent is void." While I have formed no definite conclusion I am concerned with

whether or not this patent discloses such a situation upon its face as requires the demonstration given here and requires the mathematical computation, the basis for which is or is not fixed either in the specifications or in the claims.

MR. WATSON: It is plaintiff's position on this point that that rule is put in for the, among others, explicit purpose of avoiding the necessity for experiment on the part of the practical yeast manufacturer who wants to carry out the process.

THE COURT: I wish you would get me some law on whether or not that language is to be construed by one versed in the art or whether it is to be construed by the Court not versed in the art. I assume, of course, it will have to be construed by the Court and is the Court then bound by the testimony of those versed in the art?

MR. PHILBIN: Yes, your Honor.

(Recess from November 1 to December 3, 1935.)

MR. PHILBIN: In accordance with your Honor's suggestion, Dr. Rautenstrauch is here.

THE COURT: Oh, yes. That had to do with the reading of the specification, did it not?

MR. PHILBIN: I think so, your Honor.

Will you take the stand, Dr. Rautenstrauch.

WALTER RAUTENSTRAUCH, recalled.

THE COURT: Let me have that patent.

(Patent No. 1,449,105 handed to the Court.)

THE COURT: Well, did I want the witness brought here for questioning by the Court? You

see, I have been in the midst of other cases for several weeks and I don't remember exactly where we left off.

MR. PHILBIN: Page 570 of the record I find the following:

"THE COURT: Will Dr. Rautenstrauch be here again?

"MR. PHILBIN: We had not expected to call him, your Honor, but we would be very glad to produce him.

"THE COURT: Was he here when Dr. Lamb made the experiment?"

You will recall, your Honor, that Dr. Lamb made an experiment——

THE COURT: Yes, I remember.

MR. PHILBIN: —pouring liquid from one container to another.

Then, continuing the quotation:

"MR. WATSON: The demonstration—I think he was. If your Honor has any question Mr. Philbin could doubtless ask him to be here.

"THE COURT: After the testimony is all in after you are all through I would like to ask him a question or two possibly.

"MR. PHILBIN: We would be very glad, your Honor, to have him here at the next session of this court.

"THE COURT: Then, if he comes, give him preference so he can get away.

"MR. PHILBIN: Yes, your Honor."

Apparently it was in connection with that 3 to 5 rule.

THE COURT: Yes.

By THE COURT:

Q. 520. Doctor, were you here when the experiment was carried on referred to in the testimony just read?

A. I was not, sir.

Q. 521. Have you read it in the record?

A. I have.

Q. 522. If you were called upon, upon reading this patent, to follow its instructions, would you proceed as Dr. Lamb did?

A. No, sir.

Q. 523. How would you proceed, Doctor?

A. I would proceed, in carrying out the process in accordance with the instructions in the specification of the patent by maintaining an average Balling of 3 to 5 in the wort that was employed and I would determine that during the process of manufacture, as a practical yeast man does, by testing from time to time to see that the wort is maintained in the Balling range specified in the patent.

Q. 524. Are you familiar with the practice of manufacture of yeast in yeast manufacturing plants?

A. Yes, sir.

THE COURT: That is all I wanted to ask.

By MR. PHILBIN:

Q. 525. Is there any way that you could determine the rate of feeding except by experiments?

A. I know of no way to maintain the rate of feeding, in order to maintain the Balling required or specified except by determination or test during the process.

The patent does not say anything as to what kind of materials should be used or the proportions of such materials.

Q. 527. Would there be the same rate of feed for one kind of materials as another kind of materials?

A. The rate of feed would naturally vary during the process because of the fact that as there is more yeast developed in the fermenter, as the process proceeds, there is a greater and greater demand for yeast food, and consequently the rate of feed would have to be increased in order to satisfy that demand.

Q. 528. That is, the rate of feed depends upon the kind of food you are giving to the yeast, and the proportions of such foods?

A. It would, sir, and also upon the amount of yeast, which is in the vat, which feeds on the food that is let in.

MR. PHILBIN: That is all.

CROSS-EXAMINATION BY MR. WATSON:

XQ. 529. While you were connected with the Liberty Yeast Corporation you were in control of its manufacturing processes, were you not?

A. I was in control of the business, sir, including manufacture, selling, financing, and all phases of the business.

XQ. 530. And among other things you were in control of the processes which that company followed?

A. Correct, sir.

XQ. 531. In all of that time during your active connection with that company, do you know whether the company ever followed one of the Zulaufing processes in commercial production when the Balling in the fermenter during the propagating period averaged between 3 and 5 degrees Balling?

A. No, sir, it did not.

XQ. 532. And the processes as conducted by the Liberty Company during your association with it were designed to produce maximum yeast yields and minimum alcohol yields, were they not?

A. As near as we could determine, sir.

XQ. 533. In answering the question of the Court a few moments ago, I understood you to say that if you

were conducting a process to follow the instructions of the patent in suit, '105, you would feed the reserve concentrated solution in at such a rate that the Balling in the fermenter during the propagating period would average between 3 and 5?

A. That is right, sir.

XQ. 534. At the time of your prior testimony in this case, it is my recollection you testified that that operation could be followed even though the Balling in the fermenter during the period of propagation never exceeded 5 degrees or perhaps never reached 5 degrees Balling, is that correct?

A. I don't know. Will you refer to my answers and your questions?

XQ. 535. We will disregard your prior testimony, and I will ask you whether it is your present opinion that the operation to provide an average of 3 to 5 degree Balling in the fermenter during the propagating period could be obtained without, during that propagating period, the momentary Balling or the momentary Balling at any particular reading ever reaching 5 degrees?

A. If I understand your question correctly, it is that if the average Balling in the fermenter should be from 3 to 5, then that it might at any time of the process be 5. Is that your question, sir?

XQ. 536. To obtain that result, the Balling in the fermenter might never exceed or even reach 5 degrees?

A. What result do you refer to, sir.

XQ. 537. I am referring to your testimony that the process would be so conducted that the average Balling in the fermenter, during the entire period of propagation, would be within the range of 3 to 5 degrees.

THE COURT: Would that mean that you couldn't go below 3 nor above 5? Perhaps that is a way to put it.

MR. WATSON: The second part of your statement is correct, that it would never exceed 5. As a matter of fact, of course, we are all agreed that it begins at 1 degree.

MR. PHILBIN: I don't understand any such agreement.

A. I don't understand what your question is. I will say this, in order to make it clear to the Court——

THE COURT: It says the mean content of the wort employed shall be 3 degrees to 5 degrees. I don't see how you get the 1 degree in there except that the—well, where do you get the 1 degree?

MR. WATSON: The patent, line 70, column 2, says: "A part of this wort is placed in the fermenting vat and is highly diluted (for example, to about 1° Balling)"—and the propagation is begun in that diluted portion.

THE COURT: Oh, yes.

A. I understand you are asking a purely hypothetical question; in other words, if there should be at any time, during the process, an average of 3 to 5, could there, at any time, be as much as 5 or more than 5?

XQ. 538. Dr. Rautenstrauch, I understand that you have expressed the opinion that the sentence beginning on line 90 of page 1 of the patent in suit, '105, means a certain thing. I am asking you whether, in your opinion, the operation, as you interpret that sentence, could be obtained in a certain way.

A. I must admit, sir, very frankly I cannot understand your question. The specification, as I read it, is this: the quantity of the dilute wort which is originally available for the yeast is so designed, for example, that the mean content of the entire wort employed would be 3 to 5 Balling. Now, the wort employed is the wort that you have in the fermenter. If it isn't in the fer-

menter and isn't available and used for growing yeast, it is not employed, and that is the employed wort very clearly. Now, if I understand your question correctly, the average is 3 to 5 Balling. Now to have an average of 3 to 5 Balling over a twenty-hour period, one may have a Balling of 1, 2, 3, 5, 6, 7 or 8, during some time in that process, and yet the average be between 3 and 5. I may take the average age of everyone in this room, and that is a certain value, whatever it may be, and there may be many who are over that age and many who are under that age; and so in this case if the average is between 3 and 5, there will be at times, during the process, a lower amount of Balling and a greater amount of Balling. Does that make your question clear,—does that answer your question?

XQ. 539. Yes, that is a statement of your views which sufficiently answers the question. Starting with a dilute portion having a Balling of about 1 degree and feeding in a more concentrated reserve having a Balling, for example, of 12 degrees, would the rate of feed be the controlling factor which determined the Balling in the fermenter at any time and therefore would determine the Balling curve and ultimately determine what the average Balling would be in the fermenter during the entire period?

A. No, sir, and the reason is this: The rate of feed is one factor. The amount of yeast which is present and set in the fermenter is another factor. The rate at which that yeast grows is a third factor. As the yeast consumes the food in the fermenter, the Balling tends to drop. Now, the more yeast there is in there and the more food there is consumed, the greater the tendency for the Balling to vary. So that the rate of feed does not control the amount of Balling as a primary factor. One cannot say that that is a controlling factor.

With any given amount of seed and aeration, it would not be the rate of feed which controlled because that will vary from time to time.

XQ. 541. Have you named all the variables which in your opinion would control that average Balling in the fermenter?

A. I think so, yes. I might add that it depends upon the nature of your food that is fed in. If you have a 12 degree Balling, that 12 degree Balling,—if that refers primarily to the sugar content, there may be other solids that will be absorbed by the yeast at different rates. Those, I should say, would be primarily the factors: the amount of yeast which you have present in the fermenter, its rate of growth, and the rate at which you feed in the food.

XQ. 542. I want to know all of the factors in your opinion.

A. Well, sir, those three are the principal factors.

XQ. 543. I want to know all of them.

A. Those are the three that I think of at the moment.

XQ. 544. If you had an amount of concentrated nutrient solution and desired to take a portion to dilute the portion, and then wanted——

THE COURT: To dilute what portion?

MR. WATSON: The initial starting portion.

XQ. 544 (Continuing): —and then wanted to calculate the mean Balling of your diluted initial portion, and the reserve portion, how would you proceed?

A. I would proceed as Dr. Lamb did. I have no fault to find with his arithmetic at all. It is very good.

XQ. 545. And if you wanted to demonstrate that with sugar solutions, you would give the demonstration that Dr. Lamb did, wouldn't you?

A. Absolutely; that is all right as far as a hypothetical case is concerned, it is all right. No question about it.

MR. WATSON: That is all.

By MR. PHILBIN:

Q. 546, Does that hypothetical case have any relation to a practical yeast manufacturer's problems?

A. I think not, sir.

(Witness excused.)

EDWARD E. FREE, resumed the stand.

CROSS-EXAMINATION BY MR. WATSON:

XQ. 440. Before our prior adjournment, I requested you to give me a couple of illustrative curves, showing Ballings, which would represent an average in the fermenter during the propagating period of between 3 and 5. After adjournment you gave me such curves, did you not?

A. Yes, sir, I gave them to Mr. Philbin, I imagine he passed them over to you. That is a photostat which you show me.

(Marked P-26 for identification.)

A. This is the only clean copy I have; possibly Mr. Philbin may have some more.

XQ. 443. And since the adjournment you have also given some data of nutrient solutions to be employed in connection with these curves, have you not?

A. I believe so, yes; I gave Mr. Philbin some data; I imagine he has passed it on to you. That is not data precisely, but assumptions which had been used in preparing these curves.

XQ. 444. Now, can you put those on the record, please?

A. Well, I am not sure that I can put on the record what Mr Philbin has given you, but I can put on the record what are the assumptions underlying the formation of these curves.

XQ. 445. Perhaps I can avoid any misunderstanding or embarrassment by referring to the information we have obtained from Mr. Philbin. You assumed in each case the use of 83 units of 12 degree Balling molasses solution diluted?

A. No; we did not assume molasses—of course, I should explain in the beginning that these curves are purely hypothetical and theoretical. We assume that we start with a thousand gallons,—purely arbitrary assumption,—that we are going to start with a thousand gallons. We could have assumed starting with any amount in the fermenter at the beginning. That thousand gallons was made up of 83 gallons of 12 degree Balling wort and water. To give a thousand gallons of 1 degree approximately. These are only approximate figures.

THE COURT: Why do you take 83?

THE WITNESS: 1/12 of the 1000 gallons.

THE COURT: Why do you do that?

THE WITNESS: Because you have 12 degree Balling, and we assume another—perhaps I had better outline the fundamental assumptions used to prepare these charts. The Balling is supposed to correspond exactly with the percentage of total solids in the solution. Actually, it does not do that because the character of the solids also affects the Balling, as I think I have testified before. We, theoretically, in examining these things in the laboratory, do not regard the Balling as being very important for that assumption. Now, that is the first assumption that underlies the whole thing.

That is a purely theoretical and academic calculation. Now, if that is true, then approximately a dilution of 1 to 12 will reduce the 12 degree Balling to approximately 1 degree Balling. That is the reason for taking 1/12 to start out with.

Now, the other fundamental assumptions, one of them we make is that the yeast has no effect on the Balling, which again would not be true in any actual case,—there always is some effect from the yeast. Another assumption we have to make is the percentage of non-fermentable material in the wort which would affect the Balling but which would not be removed by the yeast. There always is some such percentage. To make up these curves we have assumed 50 per cent.; you can take it anything you please.

The fourth assumption is that at the end of the fermentation there would be 2 per cent. of sugar left in the wort at the end of this portion of the fermentation covered by this curve. That, of course, could be anything. I think those are all of the assumptions made. All of them are purely arbitrary.

XQ. 448. Now, on the straight curve, that is the line commencing at the left-hand bottom at the figure 1 and going rectilinearly to the upper right-hand corner, what quantity of reserve solution of what Balling is proposed to be added?

A. 6000 gallons of 12 degree wort.

XQ. 449. And in the case of the other curve, what quantity of reserve solution of what Balling did you propose to add?

A. Approximately 1250 gallons of 12 degree wort.

XQ. 450. The feed in both cases continued over a ten-hour period?

A. Yes; not at a uniform rate, however.

XQ. 451. Is it not a fact that the patent suggests the continuation of the feed for about seven or eight hours of a ten-hour propagating period?

A. Well, I wasn't making any effort to follow the patent. I don't think these curves have any relation to the patent. I was following this diagram which you made for me, and I assumed that you meant it to run the ten hours that you have here.

XQ. 452. Do you mean to say you assumed that my questions about the curves had no relation to the subject under inquiry?

A. You asked me to prepare a certain curve. Now these curves to my mind have no necessary relation to the patent at all. I think they are just a set of exercises in arithmetic; and you gave me a chart which I have here, which has the ten-hour run, and from your questions, which I copied from the record, I assumed that you wanted me to take this ten-hour period. Now, as a matter of fact, it doesn't make any particular difference. They can be made on any set of assumptions you please. If you want an assumption for seven hours, why, we can make the curves on these assumptions. I am sorry if I misunderstood what you wanted, but I want to make clear in the beginning that I don't regard these curves as having any relation at all to the patent, the patent '105, which his Honor asked me about.

XQ. 453. Do you consider that these curves have any relation to a possible operation under the sentence beginning in line 90 of page 1 of patent '105, when that sentence is interpreted as you have expressed?

A. No, sir. I do not, no, sir.

XQ. 454. Well, I am frank to say, Dr. Free, that your answer surprises me. Will you point out, if you please, wherein these curves fail to follow your interpretation of the sentence beginning in line 90 of page 1 of the patent in suit, '105?

A. The essential thing is that this sentence requires the making of a large number of assumptions for experiments in order to determine what you mean by it. Now, I have made one set, or indeed, two sets of assumptions here. I could have made thousands of assumptions. It is possible to draw nobody knows how many thousands or hundreds of thousands of curves, any one of which would meet this particular sentence.

XQ. 455. Well, now, I am asking you whether these particular curves that you have offered meet that particular sentence, in your opinion?

A. They do, provided you add to the sentence a lot of additional information. They fall under the sentence, yes, but they have no relation to the meaning of the sentence.

XQ. 456. They are illustrative curves, are they?

A. I would say not.

XQ. 457. Under that sentence?

A. I would say not, no, because the sentence is so insufficiently specific; even if read with regard to the rest of the patent, it doesn't seem to me to be sufficiently specific to mean anything, and certainly as it stands alone it isn't, because there are so many other things that have to be specified.

XQ. 458. When I asked you for these curves, the question read as follows (Tr. 562):

"XQ. 412. In order that we may understand the opinion you expressed on that portion of the Hayduck patent '105,'' that portion being the sentence referred to, "will you please indicate on a sheet, which I hand you, the Balling curve during the ten-hour process, to represent the average Balling in the fermenter, during the operation, of between 3 and 5 degrees?'' Do you still think that these curves have no relation to the meaning of that sentence under inquiry?

A. I do.

XQ. 459. Well, understanding that I am asking you for curves, possible curves, of a ten-hour yeast manufacturing operation, to show a mean Balling of between 3 and 5 degrees in the fermenter during the propagating period, as you interpret the sentence beginning in line 90 of the first page of patent '105; would you now give me the same set of curves?

A. The only difference would be with regard to the length of the fermentation. That is, if you wished to assume the end of the feed at eight hours or at seven hours or any other time, that would have the effect of slightly raising one end of these curves. Otherwise they would be the same.

XQ. 460. You mean steepening the slope of the curve?

A. It would steepen the slope of one of them. One of them, of course, hasn't any slope; it would steepen the slope of the curve that has a slope, yes.

XQ. 461. Take those curves of this same sheet; if in fact the feed ceased at seven and a half or eight hours, and the propagation continued for the balance of the time; you would still have, would you not, an average Balling in the fermenter during the entire period of between 3 and 5 degrees?

A. I am not quite sure that I understand your question. That is, if we take, for example, the rectilinear curve in this case, and assume that the feed is to cease at seven hours, is that your present assumption?

XQ. 462. Eight hours.

A. The feed is to cease at eight hours?

XQ. 463. Yes.

A. Then the curve, in order to meet the conditions, would have to be tilted upward a little more, if that is what you mean. Now, then——

XQ. 464. No; I mean leaving the curve as it is, as a matter of fact, and letting the Balling fall off during the last two hours to about 4 Balling.

A. I think it probably would still lie within the 3 to 5 range, but that would have to be computed, to make sure.

XQ. 465-6. And the same thing with the straight line curve, is that true?

A. Well, we are talking about the straight line curve.

XQ. 466. Well, let's take the same thing about the second curve——

A. Substantially, yes. I wouldn't want, without making a computation, to say that they would lie within the 3 to 5 range, but I think they would. These have been figured on the assumption that the average would be approximately midway of the 3 to 5 range.

I never made yeast runs following such curves. I think that those curves with the quantities of materials I have given could be followed practically in a fermentation, approximately so. I haven't the faintest idea what results in yeast yield would be obtained, or in alcohol yield. I have said already that I regard the curves as being nonsensical.

XQ. 473. Do you mean that the curves and the amounts of materials which you have given are not intended to show any process which could be commercially conducted?

A. No, I mean that the curves show one out of thousands of varying processes. So that the curves have no meaning because they don't specify anything definitely enough,—precisely the same criticism that I would make of the patent, that this whole sentence that you are discussing doesn't specify anything that you can follow. I think I have said that previously.

XQ. 474. You mean if interpreted as you interpret it?

A. Interpreted as I interpret it, of course.

XQ. 475. Well, understanding the opinion that you have expressed, that these two curves are only two out of possibly a great number, is it your opinion that with the quantities of materials which you have given us, the yeast manufacturing process could be normally conducted and the feed rate such that the yeast free Balling would correspond to these curves; is it your opinion that that could be conducted?

A. I am a little uncertain what you mean by the feed rate. It is my opinion that taking the assumptions I have mentioned, these curves could be followed in a practical yeast production. It is, however, not my opinion that these curves alone would specify the feed rate that was to be followed.

XQ. 476. Oh, I understand that, but——

A. Well, I just wanted to make sure I understood your question.

XQ. 477. They specify the feed rate in this respect, that they specify what the Balling shall be at hourly intervals, for example, and that that Balling in turn will be achieved by the feed control?

A. No, I don't mean quite that; I mean that if the Balling were measured at hourly or other intervals so that this curve was followed, and that the feed then was regulated in accordance with the measurement of the Balling so that the curve was followed, I think you would have a reasonably practicable yeast propagation.

I don't know what yields you would obtain. I do not think that you would be feeding at a rate faster than the yeast could most efficiently assimilate the sugar. I think it would be approximately in accordance with the ability of the yeast to assimilate the sugar.

I think there would be alcohol produced. There would always be a small amount of alcohol produced.

I am using the word "assimilate" to mean that the yeast would take the sugar out of the solution; perhaps "assimilate" isn't quite the proper word. The assimilation of sugar by yeast presumably should be confined to the use of the sugar in the growth of the yeast itself, or in its life, whereas, of course, a small amount of the sugar actually is converted into alcohol. What I should say in this case is: we have been talking about the consumption of sugar perhaps rather than assimilation.

XQ. 483. You mean consuming sugar either to build yeast body substance or to make alcohol?

A. Or to maintain the living activity of the yeast. There really are three separable or theoretically separable ways in which the yeast consumes the sugar.

RE-DIRECT EXAMINATION BY MR. PHILBIN:

RDQ. 484. Referring to the curves on Plaintiff's Exhibit P-26 for identification, do you consider that these curves have any relation to yeast manufacture?

A. Well, they have no practical relation to it; of course, they may have a remote relationship.

The rate of feed, in order to obtain desired results of a good yeast yield and little alcohol, depends upon the nature of the nutrient solution.

In general, there would be different rates of feed for different nutrient solutions, yes, sir.

RDQ. 488. Would it be possible, except by experiment, to use the particular kind of nutrient solution that would result in either of the curves, the rate of feed curves shown in Plaintiff's Exhibit P-26 for identification?

A. Well, these are not rate of feed curves; these are resultant Balling curves. Answering what I judge to be your question, it would not, in my judgment, be possible to conduct a rate of feed such that you would

use these curves without making preliminary experiments of some kind.

RDQ. 489. You were asked about the percentage on the pH scale of the difference between a wort with ammonium lactate and a wort without ammonium lactate. You testified that this difference was about .1 and Dr. Lamb testified that in a wort varying between 4.2 and 2, the difference was about .27. Have you graphically represented the differences, .1 and .27 on the chart?

A. Yes, sir.

RDQ. 490. Will you please explain the chart that I have handed you?

MR. PHILBIN: Your Honor may recall that there is a substantial issue in this case as to the effect of ammonium lactate and also di-ammonium phosfate as a neutralizing agent in worts such as defendant's, and that Dr. Free testified there was a certain effect, very small, and Dr. Lamb testified that the effect was about twice as large, namely, .27 as against .1.

A. I observe, in looking at this re-drawing of the chart, there are two minor misprints. At the upper right-hand corner the word "granis" should be "grams," and also the 27 figure at the extreme left of the chart is .27 instead of 27. Now, by way of explanation, the left-hand side column headed "pH" gives the pH scale as it is ordinarily given and inserted on that are some of the special figures, 4.6, 3.1 and so on, which have been discussed in the case. The right-hand column gives the same data in the form of the actual concentration of hydrogen ions in the solution. This is assumed, of course, to be pure water and so on. That scale on the right begins at the bottom—at a pH of 7.0, corresponding to neutrality—begins with one of the units specified at the top, that is to say, one

unit consisting of 10 to the minus 7 grams per liter of ionic hydrogen; then the other figures rising from the bottom on the right-hand side give simply this number of those units of ionic hydrogen present in a liter of solution at the pH values given on the left. This, of course, is not in any sense personal data; this is merely an arithmetical, mathematical presentation of the pH scale.

RDQ. 490a. I will ask you to write above the .2 the words "Dr. Lamb" and underneath the .1 "Dr. Free."

RDQ. 491. Now, what is the range of hydrogen ion concentration within which yeast manufacture can be safely carried on?

A. Well, I believe I have testified that that range might run between 3.5 and 5.5. As I recall, Dr. Lamb's range was a little different for that. I think his range was between 3.1 and 4.6—was it? I think that is what he gave. My range was between 3.5 and 5.5 and Dr. Lamb's, I believe, was between 3.1 and 4.6. Those, of course, are matters of judgment. There is no definite answer as to that.

I would say that the range within which ordinary commercial variations may occur from day to day because of difference, say, in raw materials or similar ordinary vicissitudes, would be somewhere close to these two ranges, somewhere between 3.5 and 5.5, probably. I would have no particular criticism of Dr. Lamb's range. I would put it a little higher.

In a range of from 5.5 to 3.5 the difference in hydrogen ion concentration, that is, the number of ions, as shown on the right-hand side of the chart, is between 32 of these ionic units at 5.5 and 3163 of them at 3.5. That would be a difference of 3131.

I would say it does not make any practical difference whether there are 32 or a hundred or a thou-

sand or three thousand ions, so far as the growth of the yeast is concerned. Whether there were 316 or a thousand ions would certainly make no difference.

(The chart referred to was offered and received in evidence and marked Exhibit D-10.)

RDQ. 497. The chart has at the bottom lines 7.0 and also 1. What do those figures indicate?

A. That corresponds to what is theoretically called neutrality. That means an ionic concentration of 10 to the minus seventh grams per liter.

If those lines continue downward, that would go into a region of alkalinity or basicity. It usually would be called alkalinity. That would be the antacid region.

RDQ. 500. You were asked by the Court regarding the Hayduck '105 patent, particularly the .3 to 5 ratio, and you answered (Tr. 535) that: "During the progress of this aeration and the growth of the yeast, you add additional quantities of the original wort, 12 degree Balling, substantially continuously at a rate such that the alcohol formed can be consumed, assimilated by the yeast." Did you mean that the patent discloses or teaches what that rate should be?

A. No, sir, it does not disclose the rate.

I think the patent does not give any indication of what the rate should be, except that indication that the alcohol is to be assimilated, and that, of course, would have to be determined in some fashion; it is not specified in the patent.

That determination could not be made by calculations. It would be necessary to experiment in order to ascertain what that rate should be. And, of course, in my judgment, even that would not work, because we made the experiment and we concluded that there wasn't any assimilation. However, that is a matter of dispute in the case.

RDQ. 503. If it was impossible to find out whether the yeast was assimilating alcohol, could even experiments determine what the rate of feeding should be, following the teachings of the patent?

A. Well, the patent also states that the rate of feed is to be such that the yield of yeast will be high, with little or no formation of alcohol. That, of course, could be experimented on, and it would be possible to determine a rate of feed which would give a relatively high yield of yeast and a relatively low production of alcohol. That would be substantially the same as one of the patents previously discussed, the Rainer patent.

It is possible to grow yeast with a considerable variety of nutrients and with a considerable variety of portions of such nutrients, and to produce yeast satisfactorily. That is, in substantial commercial yields, without much alcohol, the conditions being suitable for the kind of nutrient used.

MR. PHILBIN: That is all.

RE-CROSS-EXAMINATION BY MR. WATSON:

THE WITNESS: My judgment is that in 1915 it was known that different yeast nutrients would have different rates of assimilation, but I would hesitate to give a definite answer without looking up the literature.

RXQ. 508. You were asked as to the difference in effect of 10 units of hydrogen ions on the scale of your Exhibit D-10 and 3163 on that scale. Would there be a difference on the yeast between the 3163 and the 10,000 on that scale?

A. There would be, in my judgment a difference. For the reason that the 10,000 goes beyond the range that we have all agreed upon as being suitable for the growth of yeast.

MR. WATSON: That is all.

MR. PHILBIN: That concludes, may it please the Court, the defendant's case, with the exception

of the following: First, plaintiff's counsel has given us the following figures for the nitrogen to sugar ratios of various worts described in the patents in suit, namely:

Hayduck, 1,449,103, 1.5 to 4 nitrogen per 100 sugar

Hayduck, 1,449,106, about 5.5 to 8.5 nitrogen per 100 sugar

and

Corby, et al., 1,673,735, about 3.33 nitrogen per 100 sugar.

Second, it is stipulated that each of the applications for the Hayduck patents in suit was assigned to The Fleischmann Company on August 5, 1920.

Third, suit was brought by the Fleischmann Company in 1924 in the District Court of Maryland against Liberty Yeast Corporation on the patent to Pollak, 1,123,920,

Hayduck, 1,440,102-3-5-6,
Nilsson, 1,449,127,
Wohl, 1,449,134,
Kohman, et al., 1,475,494,
Wohl, 1,475,215, and
Corby, 1,475,471.

The bill of complaint contained the allegation, referring to the alleged inventions of these patents that "plaintiff has been and now is using them conjointly in the conduct of its business of manufacturing and selling yeast," and also that "the use of said inventions has been profitable to plaintiff and of great benefit to the public."

4. Plaintiff's counsel stated (Tr. 419) that I was counsel in the Standard Brands v. Federal litigation. I had no connection with the first suit.

In the second suit, Mr. Charles H. Howson of Messrs. Howson & Howson, Philadelphia, was in complete charge and control of the defense. I was called in shortly before the trial commenced, was present during some but not all of the trial, and examined no witnesses. The case was prepared and tried by Mr. Howson, and, like any other lawyer, I would have tried the case differently, and I would have put in different evidence.

5. With respect to the prior art which was before the Court in the prior suits and during the prosecution of the applications before the Patent Office, defendant here has cited the Jacqueman, Roth, Lavedan, Wiifert, Brenner, abstract of Henneberg article and "American Distillers' Review," with respect to molasses, inorganic ammonium salts and neutralizing. None of these was either before the Court in the prior suits or was cited by the Patent Office. In addition, defendant has also cited the patents to Pollak, Polsky, Fritsche and Molhant, and the "Pure Products Magazine." Polsky and Fritsche were not in evidence in the prior litigation.

Polsky was mentioned in the prosecution of the application for the '106 patent only and Pollak was referred to in the prosecution of the '103 and '109 applications; the other references were not referred to by the Patent Office, but were in one or both of prior suits.

With respect to the references cited here by the defendant against the idea of regulating feed, or Zulauf, namely, Iwanowski, Rainer, Delbruck and Lafar, they were in evidence in the prior suit on the '105 and '106 patents and were referred to in the Court's opinion except Iwanowski. Except for Rainer, they were not mentioned during the prosecution of the applications in the Patent Office.

6. The date that the plaintiff first used the so-called Zulauf process was in 1923. There was some doubt in the testimony as to whether it was first used in 1922 or 1923. I understood that it was in 1923.

7. With respect to the second suit against the Federal Yeast Company involving the '105 and '106 patents, the record there shows that the defendant, in that case, never made any tests of the Rainer German Patent 10,135 for yields of yeast but merely made some peptones according to the defendant's understanding of the Rainer patent. There was no testimony as to the 3 to 5 ratio or the Ballings of the Hayduck '105 patent, until plaintiff's expert witness, Dr. Lamb, referred to it in plaintiff's rebuttal case; and the testimony in the record regarding this matter is by him only. Finally, in that case, there was a reference to buffering materials in defendant's wort but defendant offered no evidence as to the amount of difference that such buffering materials made in its process. Finally, there was no evidence in that case by the defendant, nor I believe by the plaintiff, as to whether or not yeast would assimilate alcohol in normal manufacturing processes.

MR. WATSON: I am sorry that Mr. Philbin did not give us an indication of his statements that he wanted on the record earlier, because we have not checked them and I caught some errors as he made the statements. Now, I don't know how many other errors there are in it; I know, of course, that there are none of them intentional but I must reserve——

THE COURT: You may reserve your right to check it, and subject to that it will be received.

MR. WATSON: And add anything of comparable character.

MR. PHILBIN: We have no objection to offering as a physical exhibit all that prior litigation as explanatory of the opinions of the Court.

MR. WATSON: I think that had better include the pleadings too.

MR. PHILBIN: Yes.

MR. WATSON: And exhibits.

MR. PHILBIN: That may be offered as Exhibit D-11.

(Received and marked Exhibit D-11.)

MR. WATSON: I offer as Plaintiff's Exhibit 26 the photostat of curves supplied by Dr. Free heretofore marked for identification.

(Received and marked Exhibit P-26.)

PLAINTIFF'S REBUTTAL PROOFS.

ARTHUR B. LAMB, recalled in rebuttal, testified as follows:

DIRECT EXAMINATION BY MR. WATSON:

Q. 614. Dr. Free testifying for defendant stated that in yeast manufacturing processes using inorganic salts of ammonium, the greatest danger from acidity occurred at the end of the propagating operation. Do you agree with that?

A. No, I don't agree with that statement. In my opinion, the greater danger exists earlier in the propagation, during the active multiplication of the yeast. Acidity has a greater influence at that stage of the process than later. And then again there is the fact that it is widely known that consumption of acids occurs in the latter stages of yeast propagation. Lactic acid and similar acids are consumed, as has been repeatedly brought out in the testimony, at this time. This tends

to diminish the acidity at the end and it is not unusual to add acid even along toward the end of a yeast propagation process to counteract this diminishing quantity of acidity.

Q. 615. On page 555 of the record Dr. Free was asked on cross-examination and replied as follows:

"XQ. 359. I will amend the question by asking you whether you were aware that in defendant's operation as shown by those mash sheets and as described in its answers to our interrogatories the defendant did use a nutrient solution containing free lactic acid?

"A. Yes, sir, there would be some free lactic acid in the soured mash."

"XQ. 360. Did you in your tests provide the presence of lactic acid in corresponding amount?

"A. No, sir, that would be a negligible quantity."

Do you agree with the statement in the last answer, that the lactic acid in defendant's commercial operations was of a negligible quantity?

A. No, it was not negligible by any means, as I brought out in my testimony in connection with the situation at the end of the sixth hour. In such an operation the titratable acidity at the beginning, 1.5, necessarily represents lactic acid or the equivalent, some similar acid, largely lactic acid, and when this amount of titratable acidity is translated into total amount of acidity, the volume of the nutrient solution being very large at that time, it amounts to a very considerable total acidity due to lactic acid, that is comparable in magnitude to the acidity derived from other sources of acidity. To this is also added the lactic acid furnished by Zulauf; at the sixth hour, something like 600 gallons of Zulauf which, as I remember, had an acidity of 4.0, has been added, and that again translated into lactic acid represents a small but nevertheless significant addition of lactic acid to the total amount of lactic acid

in the nutrient solution. So that the lactic acid, as a whole, is a significant amount, as was disclosed when the equivalent amount of it was added in the experiment under discussion, where the pH's were measured. So that it is quite out of the question to speak of that lactic acid as insignificant.

Q. 616. You heard Dr. Free's testimony to the effect that the experiments you described, giving comparable yeast yields in the one case from molasses and in the other case from three-quarters of the amount of molasses and one-quarter of the amount of alcohol, might be explained on the assumption that some other factor, such as nitrogen, limited the yield in both cases, and that no alcohol was consumed by the yeast in the second case. What can you say as to whether Dr. Free's criticism or explanation is consistent with the facts of such tests and consistent with the facts as known to you?

A. The objections that Dr. Free raised to those experiments were hypothetical in nature and were quite wide of the mark. His chief objection was possible lack of nitrogenous nutrients; as a matter of fact, in those experiments, tests were made which demonstrated the presence throughout the run and particularly at the end of an adequate supply of nitrogenous nutrient. So that there is nothing in that objection, or in the others. I pointed out that these results at that time were only susceptible of explanation on the basis that alcohol was actually consumed by the yeast in the presence of the sugar. Our experimental work has confirmed this in every respect, and our experience, and there is no reasonable doubt of the accuracy of this statement. Yeast will consume alcohol under these conditions.

Q. 617. Dr. Free testified that he had made an experiment to find out how much alcohol in a wort solution was evaporated off by the air blown through dur-

ing aeration. Do you recall how much air per liter he used?

A. In these experiments spoken of, Dr. Free used 10 cubic feet of air per minute through a solution, nutrient solution, of about 100 liters, and he obtained, with alcohols of 1/10 and 2/10 and 3/10 per cent. concentration, losses of something like 50 per cent. of the alcohol present, when the blowing was continued for 10 hours. Now, of course, I don't subscribe to these experiments. I am confident that some gross error occurred in them. They are in marked discordance with experiments of Mr. Luce and our experience; so that I am sure there is something wrong. They are also, as I pointed out in my previous testimony, quite contrary to the experiments of the Raoult's law. Something like four times the loss is obtained in these experiments which would be theoretically possible by Raoult's law, and while——

THE COURT: What is that law?

THE WITNESS: That is the law that governs the amount of vapor given off by a liquid at any temperature as dependent on the percentage composition of the liquid.

A. (Continuing.) So I am quite convinced that these figures are in serious error. Nevertheless, perhaps this is an academic discussion, because even taking the exaggerated figures of Dr. Free, and the erroneous ones in my opinion, when these are applied to the rates of aeration followed in commercial practice, and the amounts of liquid used in commercial practice, the percentage loss on these very figures, due to the lesser amount of air that is blown through, and the greater amount of liquid employed relatively, comes down to about 11 or 12 per cent. loss of the alcohol

present from a dilute alcohol solution of this sort. So that even granting these figures, they are quite unable to explain the drop in alcohol concentration observed in Mr. Luce's experiments, demonstrating the consumption of alcohol by yeast. Because it would all have been blown out, to explain Mr. Luce's figures, and according to Dr. Free's figure only 11 per cent. or 12 per cent. would have been blown out. So that Dr. Free's computations, even accepting them on the very high basis on which they rest, are quite inadequate to explain the loss of alcohol in these experiments. The alcohol must have been consumed. That I am confident is the case. Moreover, you have to remember that in Dr. Free's experiments the blowing was continued for ten hours. In Mr. Luce's run there were only two or three hours available for this alcohol to be blown out —only a third or a quarter of the time which Dr. Free blew, which would reduce the 11 per cent. down to a still smaller fraction, perhaps 3 or 4 per cent. So that this attempt to explain the disappearance of alcohol in these mashes as being due to the consumption of the alcohol by the yeast, is quite in vain.

Q. 618. There has been some discussion of yeast yields. Do you know whether the Handbuch of Kirby gives a statement of the commercial yeast yield obtained in a straight set plant operation? Does the textbook refer to a 4 degree Balling in a straight set plant operation?

A. Yes, it does. On pages 570 to 571, it describes the manufacture of yeast by the so-called "New aeration process." This book was written in 1912, and it tells in some detail about the conduct of such a process of yeast manufacture. The initial sentence reads as follows:

"A solution of 4 to 4.5 degrees Balling is to be considered as favorable."

It tells about the dilution of—it might be better to translate the whole thing, although it may take a little time.

Q. 620. All I want is the yield. I want to have on the record the common yield in a straight set operation about that date.

A. I think perhaps I can answer your question best by translating a few lines from the middle of this paragraph on page 570. I might say in preface to this translation that this process, of course, is a straight-set process for the manufacture of yeast.

"In order to secure a final wort of 4 to 4½ degree Balling from 3000 kilograms of grain or mash materials, the above-mentioned method of procedure outlined is to be chosen which will give perhaps 1400 or 1500 liters of wort for every 100 kilograms of mash material, so that at the end of the filtering operation there will be about 42,000 to 45,000 liters of filtrate. With this quantity of final wort one can obtain up to 40 percent of yeast, together with 12 to 13 percent of alcohol, this latter in a dilution of perhaps .8 to 1.0, the yeast growth encountering no obstacles under these conditions."

THE COURT: What is the date of that?

THE WITNESS: 1912.

I am familiar with Plaintiff's Exhibit 26, the illustrative curves that Dr. Free offered. I recall the quantities of nutrient solution which he specified for use to produce these. 83 units of 12 degree Balling material diluted to provide a thousand gallons at the start, and in the case of the straight line curve 6000 units of the 12 degree was added. And in the case of the curved line 1250 units added. I had tests made with those amounts to determine the operation or operativeness of such a process. Indeed, I took part in these tests and endeavored to follow the curves that

Dr. Free had outlined and the additions which he had specified.

Q. 625. What were your findings as to the possibility or impossibility of following those curves with those quantities?

A. Well, we couldn't really follow them, to be sure. We could prepare the initial solution, of course, and after some practice we were able to follow the earlier parts of the curves, but we soon found that in order to follow these curves we had to add material in quite different rates and ultimately in different amounts than he had specified, so that we just couldn't follow the end of the curves at all. The material either gave out that we had available to add or in one instance the fermenter overflowed. We could not get it all in, so that we could not follow these curves with the amounts that Dr. Free specified; they weren't operative. Of course, what we did do finally was to follow these curves and added as much more as was needed of material and thus to follow the curves up to the end. In other words, we did succeed ultimately in following the curves but in using different amounts of materials than he had specified.

I have two graphs here showing our tests in that regard, one to show the results we obtained in following the rectilinear curve and another to show the results of following the more gradual and bending curve.

On those graphs the figures underneath the curves or lines themselves are the amounts of material added per hour to the fermented. The full lines correspond with the curves in Plaintiff's Exhibit 26, as I can verify it by comparing with a photostat copy of that exhibit. The red dotted lines follow the points as we were able to obtain them by the additions, as indicated.

The feed was stopped in each case at a period somewhat short of the ten-hour period shown in the

whole diagram, stopped at the seven and three-quarters hours in the rectilinear curve—had to stop there because the fermenter was filled up, and it stopped at the eighth hour in the other curve. Thereafter there was no addition of wort, Zulauf was stopped, and our curves naturally fell off rapidly, due to the fermentation of the sugar and the growth of the yeast.

(The graph showing the arcuate curve referred to by the witness offered and received in evidence and marked Exhibit P-27.)

(The graph showing the rectilinear curve referred to by the witness offered and received in evidence and marked Exhibit P-28.)

Q. 632. Will you please tell us what yields of yeast were obtained in these two operations?

A. We determined the yield of yeast at the conclusion of the feed in each case, and at the conclusion of the whole ten-hour period. These yields were as follows:

For the rectilinear curve, Plaintiff's Exhibit P-28, at 7¾ hours, 24 per cent. yield; at 10 hours, 30 per cent. yield.

And for the other curve, Plaintiff's Exhibit P-27, at the eighth hour there was a yield of 27.4 per cent. and at the tenth hour 35.8 per cent. of yeast, all on the 30 per cent. solid basis.

Q. 633. Will you please mark on Plaintiff's Exhibit P-27 with a red pencil to indicate the time in hours at which the amount of reserve specified by Dr. Free had all been fed in and had become exhausted?

A. I shall have to add these up. From my memory, I have only an approximate figure.

This point was reached in the case of the curve in Exhibit P-27, between the conclusion of the third and the fourth hour.

Q. 634. Will you make the same indication on Exhibit P-28 at the time when the 6000 units of reserve had all been fed in and thus had become exhausted?

A. This point was reached in the rectilinear curve Exhibit P-28 between the conclusion of the fifth and the sixth hour.

In the yields I have referred to this figure of yields was given on the basis of the molasses.

Q. 636. As the result of these tests did you find whether the operations as thus conducted involved and required a rate of feed such that the process was not so conducted for maximum yeast yield and minimum alcohol yield as it might otherwise have been done?

A. Yes, they did involve a rate of feed so high that the advantages of high dilution were entirely lost and a low yeast yield, on one hand, and favorable conditions for an alcohol production on the other hand, obtained.

At the end of the operation there was assimilable nutrient material in the solution which went to waste. The Balling was dropping at the conclusion of the experiment, as these curves demonstrate.

MR. WATSON: That is all, Mr. Philbin.

(Recess.)

By MR. JOHNSON:

Q. 637. Dr. Lamb, there are one or two places in the record as to which counsel are unable to agree on corrections to your testimony. The first one is in the last sentence on page 425 of the transcript, particularly the first portion of it. Will you tell us what the language should be and how it now reads?

A. Of course, I can't remember back so far as to my precise words, but I do know what my meaning was intended to be. It at present reads or at least it is typewritten as follows:

"The yields obtained were such as could not have been obtained solely from the molasses present,"

What I had in mind was that the yield obtained in the second case was such as could have been obtained solely from the molasses present, because that was, of course, all I was talking about.

THE COURT: You would like to amend it, then, to bring in that phrase?

THE WITNESS: That phrase "in the second case." Otherwise it makes it absurd.

Q. 638. The next one is on page 441 in the sentence which now reads: "In general, it was the ordinary wort fed into the vat and fermentation started and the remainder of the solution fed in to this solution with rapidity depending on the yeast manufacturer's schedule a few hours or more as required." That sentence had reference to the Delbruck article. Will you tell us how the last portion of that sentence should read?

A. If it were changed to read "depending on the manufacturer's schedule" it would agree with the meaning I had in mind. I clearly recognized at that time that this was a process for the manufacture of alcohol and not for yeast, and it must have been an inadvertence if I slipped in the word "yeast." The second line or two following brings that same point out.

Q. 641. And the last one is on page 444 in which you were discussing the arithmetical mean between a solution having a 1 degree Balling and another solution having a 12 degree Balling. The sentence now reads: "The total material added then on that basis would be 13." Will you please tell us what change should be made in that quoted portion?

A. Well, I think the present reading, if it is read understandingly, is correct enough, but it is true that we have used the word "added" in this testimony at the trial for the similar material, material added to

the diluted portion already in the fermenter; and my phraseology would be a little confusing. It would be better to have the sentence in question read: "The total material used then on that basis would be 13," changing the word "added" to the word "used." That covers not only the actual material added in the Zulauf but also the material already present in the fermenter in the dilute solution, which it was my intention to state.

MR. WATSON: That is all, Mr. Philbin.

CROSS-EXAMINATION BY MR. PHILBIN:

XQ. 642. At what hour in defendant's process do you consider that there is the greatest danger from acidity?

A. Do you want that a generalized question, covering all the different runs which have been testified to, Mr. Philbin?

XQ. 643. You may answer with respect to the M177 process, Plaintiff's Exhibit 14, which described some of the operations in April, 1931.

MR. JOHNSON: Plaintiff understood that was a typical operation. What do you mean "by some of them"?

MR. PHILBIN: There were several operations during April of 1931 and this sheet, as I understand it, showed one of such operations.

MR. JOHNSON: Typical.

MR. PHILBIN: There were also operations in September, 1931, and December, 1932.

A. Well, I should hesitate to pick out any particular hour, Mr. Philbin. I should say that in the early to middle portion of the run the danger was the greater.

XQ. 643. Is that true also of the September, 1931, operations?

A. I haven't those here.

XQ. 644. The reason I am asking this, Dr. Lamb, is because Plaintiff's Exhibit 21 purported to show conditions at the end of the sixth hour, and I wanted to know from you why you selected that particular hour, whether you considered that the acidity at the end of the sixth hour was the most dangerous or whether there was some other hour during the process that you considered the most dangerous.

A. Well, that is a less extensive question and easier to answer, I think. I picked the sixth hour because I wanted to take some point intermediate between the beginning and the end. Dr. Free's experiment had been made and his testimony had been based on the solution obtained by mixing all of the ingredients together at the end, and he had observed such and such a hydrogen ion concentration in his mixture. I wish to bring out the fact that had he taken an intermediate period—I picked out the sixth hour, I think, largely as a matter of convenience, because I wanted to get somewhere near the middle of that period that this proportionality between the amount of neutralizing material and acidity liberated no longer obtained and that a more acid condition resulted in this intermediate state than would have been obtained in the final state that Dr. Free has talked about, the hypothetical condition, where the neutralizing ingredients of his materials were brought to bear on the acids that might have been present, and it is quite likely that some other hour could have been found that would have shown still greater error on his part. I didn't have time to make but one calculation; it was quite laborious as you recall, and it is quite possible that had some other hour been selected I would have found a still more marked effect of the extra neutralizing agent present and added in the form of ammonium lactate.

XQ. 645-7. Will you now answer the question as to whether you consider that at the end of the sixth hour

or at some other hour in defendant's process the danger from acidity is the greatest, if you know?

A. Well, I don't know that I know. I think it would depend on the acidities that actually prevailed in the experiment in the run at that time, how near the danger mark the operator was.

XQ. 648. Does the yeast consume lactic acid in such worts as we have been considering here?

A. Yes, it does.

XQ. 649. And by lactic acid I mean lactic acid and the lactate which might be formed from it.

A. No, I don't think it consumes lactate; I think it is unlikely that it does that. I think it consumes the lactic acid.

It is difficult to answer whether it prefers lactic acid to sugar; I don't really know.

XQ. 651. That is, you do not know whether or not, if sugar and lactic acid are equally available to the yeast, whether the yeast will consume sugar in preference to lactic acid. Is that a correct statement of your position?

A. Well, I know that yeast will consume and assimilate lactic acid under suitable conditions. I also know, of course, that it does the same thing with regard to sugar with great ease. There are certainly conditions under which it will, I think, take sugar in preference to the lactic acid, but I don't think it is an exclusive tendency even then.

I referred to some statements by Dr. Free regarding the alcohol experiments of Plaintiff's Exhibit 20, entitled "Molasses check and molasses plus alcohol run for yields of molasses in the presence of alcohol." I did not perform those experiments.

I was not present during the carrying on of these experiments. However, I did know about the experiments and I arranged for their performance.

XQ. 654. How much nitrogen was used in each of these two parallel experiments, that is, was the same amount of nitrogen used in each case?

MR. JOHNSON: You mean added nitrogen in the form of ammonium salts?

MR. PHILBIN: No, I mean nitrogen available for the yeast.

A. Approximately the same, yes, and in both cases there was an excess of ammoniacal nitrogen present at the end.

XQ. 655. What happens to the nitrogen when it is used for yeast food, does a part of it go into the yeast cell structures and part of it go into the making of new yeast cells?

A. You mean that part of the nitrogen is assimilated by old yeast already present in cells and part by the newer daughter cells that are formed?

XQ. 656. Yes.

A. Well, I suspect that part of it goes to both; yes; I am quite sure it does.

XQ. 657. Does this chart, Plaintiff's Exhibit 20, show that there was the same resultant nitrogen in the product, that is, the same protein in the yeast cells and the same yeast yield, or that there was more nitrogen in the product in the second case than there was in the first case?

A. The protein content of the yeast was somewhat higher in the second case. That is the case where alcohol was one of the substances assimilated by the yeast.

XQ. 658. How do you explain that?

A. Well, the variation isn't much more than the experimental variations—very slight. It is 2.5 per cent. To derive the 2.5 per cent. I subtracted from 53.2, the second experiment, 50.7, the value of the first experiment, leaving 2.5 per cent. difference, as I get it. That is protein.

XQ. 661. And was the yield also greater in the second case?

A. (No answer.)

XQ. 661. (Continuing.) In the first case was the yield 104.3 and in the second 104.5, according to Plaintiff's Exhibit 20?

A. Yes.

XQ. 662. You have referred to Raoult's law, which you said you used in determining alcohol evaporation. What factors did you use in applying that law?

A. I used the known molecular weight of alcohol and water and the given percentage composition of the solution. Nothing else.

XQ. 664. You are quite sure that those were the only factors you took into consideration in your application of Raoult's law?

A. Well, there are various shortcuts that I might have taken. I could have used some additional data. I will look it through—I think I have it here. Yes, I used the vapor pressures of alcohol and of water. It wasn't absolutely necessary to do that, but it simplified things; and I used the vapor pressure of alcohol at 30 degrees, pure alcohol, and I took it as 79 millimeters pressure.

I did not use any other factors. That is all I used.

XQ. 666. Does Raoult's law hold good for any solutions except ideal solutions?

A. It holds with mathematical exactness only for ideal solutions. That's why they call them ideal, because they do obey Raoult's law exactly.

XQ. 667. Does the correctness of the law depend upon the internal attraction of the molecules of the different materials that are being used?

A. Well, I don't know whether that is the factor that makes them vary or not. It is quite a difficult theoretical question, why some substances do deviate from the exact requirements.

XQ. 668. Are deviations from Raoult's law the greater as the internal pressures of two molecules in the solution of different kinds vary?

A. I don't know what you mean, Mr. Philbin, by internal pressures. If you want to follow along that line of attractions—of course, alcohol does dissolve quite readily in water. I want to help you all I can. And you might say there was an attraction between it, but, of course, in that case too you would then deviate another way from Raoult's law. It ought to give a lower pressure than Raoult's law. You see, that would work the wrong way, Mr. Philbin.

If the two molecules, say a water molecule and an alcohol molecule are in the same solution, I think the rapidity with which they depart from that liquid solution into the vapor condition will depend upon the attraction between those two molecules; it will evaporate less rapidly if there is a strong attraction.

XQ. 670. If the two molecules are substantially identical, will their evaporation, that is, their going into the vapor condition, be about the same as it is when they are in the liquid condition?

A. Well, I don't think that one can say that, no, Mr. Philbin.

XQ. 671. Do you agree with this statement: "Hildebrant has shown that liquids having nearly identical internal pressures do, in fact, form ideal solutions. Where deviations from it are greater, the greater the difference of internal pressures?"

A. Yes, I think I agree with that, if you understand by that the internal pressure which he had in mind.

The internal pressure of water varies a great deal with temperature. This quantity that Hildebrant speaks of is a hypothetical quantity that has never been measured; it is a theoretical quantity. I think it has been estimated as of the order of 1000 atmospheres.

I don't know what the internal pressure of alcohol is. The temperature makes a relatively slight difference in the application of Raoult's law.

In my calculations I assumed a constant figure for the alcohol in the solution because that worked against my calculation, it favored yours; that is, it would give a greater loss than my percentage assumed; that is, if I took account of the diminished concentration, the loss of alcohol would be less.

XQ. 676. In defendant's wort is the amount of alcohol, if any there be, varying from time to time?

A. Well, I suspect it does vary slightly as it is consumed by the yeast.

XQ. 677. Would substances other than alcohol or water, if present in a solution of alcohol and water, make a difference with respect to the evaporation?

A. Very slight. All of these differences are very minor ones, Mr. Philbin, that have no particular pertinency on the broad experiments that I used the law for. I wasn't attempting an exact calculation; I was careful not to do so.

XQ. 678. Do you not consider that a better way of determining what was the alcohol evaporation on a wort such as defendant's, would be to actually test it rather than applying such a rule as Raoult's law?

A. Well, it is a difficult experiment, that to do correctly would take a long time. We didn't have time to do it in the short period at the trial, do it properly. I think you will see from the divergencies between Dr. Free's experiment and Mr. Luce's that there was a great difference of opinion based on those experimental differences.

XQ. 679. Did you understand that Mr. Luce made any experiments the results of which were offered in evidence here for the purpose of ascertaining the amount of alcohol evaporation?

A. No. I don't think there were any.

XQ. 680. Referring to Plaintiff's Exhibit P-27 and P-28, what materials did you use in your experiments?

A. We used molasses and nutrient salts. I could give you the details.

XQ. 681. What salts?

A. We used ammonium phosfate and ammonium sulfate, and ammonia—of course, ammonia isn't a salt, but we used ammonia for neutralization purposes. That is all.

I used those materials in obtaining the results shown in both my curves. Those experiments were performed about a week ago at the Fleischmann Research Laboratory in New York City. They took all day.

I think we performed about four such experiments. The first two we didn't succeed in keeping on the curve. Our points were, to use a colloquial expression, all over the lot; although we did our best, we found it very difficult to adhere to the curves. With these rates of feed, you are putting in so much nutrient that, of course, the yeast can't assimilate it and you have what the yeast makers call sugar Balling there a great deal of the time—almost impossible conditions for yeast manufacture; and we just, frankly, had to do it over again in order to find out how to do it.

XQ. 691. What percentage of solid materials was employed—that is, non-fermentable solids?

A. Well, I haven't that right in my mind, but we used the best procedure we knew for the propagation of yeast under those conditions by the Zulauf process. It was entirely a conventional procedure, no variations that I know of. We didn't try any other materials.

XQ. 691b. Would you have obtained the same result if you had used merely sugar and nutrient salts?

A. Well, when you have purely sugar, you have to make corresponding changes in the nutrient, in the nitrogenous supply, and we presumably would have had to have made different additions of ammonia, because,

of course, we maintained an optimum acidity throughout by the addition of ammonia from time to time, keeping track of the pH value in the solution constantly. Now, those would have been different had we used sugar.

We fed the nutrient solution at the particular rates that we did primarily to obtain the points on the curve. We felt that the first requirement for an attempted repetition of this experiment was to follow Dr. Free's curves, and we tried religiously to do that; and, as I told you, we did succeed after two or three trials in following it fairly well. We felt rather proud of those curves in red, in view of the difficulties that we had before. We used a temperature of 30 degrees. If we had used 24 degrees centigrade we wouldn't have obtained the same results. If we had used 17 degrees centigrade we wouldn't have obtained the same result. We used 300 cubic feet of aeration.

XQ. 698. If you had used an all-grain wort, would you have obtained the same result?

A. I suspect that had we prepared a wort of similar Balling that to start with the results would not have been very different—they would have been somewhat different.

XQ. 699. Does an all-grain wort contain more nonfermentable solids than a molasses-and-salts wort?

A. I think it would depend, but it contains less usually.

XQ. 700. The all-grain wort contains less fermentable solids than a molasses-and-nutrient salts wort?

A. I am really not very sure about that, Mr. Philbin. I think there is nothing specified in the Hayduck '105 patent which states that a wort containing molasses and salts should be used, nothing beyond the statement that a wort of normal concentration should be employed of normal quality. That might include a variety of raw materials.

XQ. 702. Anything in the Hayduck '105 patent which states that the temperature employed should be 30 degree centigrade or about such a temperature?

A. No, I don't think that Mr. Hayduck was attempting to teach the yeast art the use of a special temperature or new temperature.

The temperature would make no difference with respect to the results other than what any yeast manufacturer would have known and anticipated.

XQ. 704. Can you tell us what the yeast manufacturers knew at that time with respect to temperatures?

A. Well, I don't know that I can tell you all that they knew, no, but they knew very well there were limits beyond which they ought not to go in either direction, and that low fermentation temperatures, low propagation temperatures, involve slower procedures, longer periods of growth.

XQ. 705. In Plaintiff's Exhibit 28 would not your curve have approached closer to Dr. Free's curve if you had used a lower temperature?

A. I think it would take a long time and practice for anyone to get any closer to those curves than we did. I personally could not have done it so quickly, but I had the advantage of two very skilled operators to help me on it. I am sure I never could have hit the curve so accurately and I don't think many people could have done as well as we did, and I certainly don't think we could have done any better under any temperature conditions.

The yeast would have taken longer to eat the materials if a lower temperature had been used. That is usually the case. The solution employed would have lasted longer if a lower temperature had been used. They wouldn't have run out of solution so soon. That would simply have meant that we would have wasted more; we wasted a huge amount of sugar as it was. It

simply meant that instead of wasting half of our sugar, as we did in this case, in getting a miserable yield, we would have wasted perhaps two-thirds of our sugar in the ten-hour period. The Ballings that we built up there, Mr. Philbin, our sugar Ballings, they represent the food that the yeast cannot consume.

XQ. 708. Referring to figure Plaintiff's Exhibit 28 there is a red vertical mark at about the fifth and a half hour. What does that red mark indicate?

A. That means when the solutions were all used up that were added; when we had added all that Dr. Free had specified and had still only gotten one-half the process as a whole.

XQ. 709. And if you had used a lower temperature would not the nutrient solution have lasted longer?

A. Yes, if we had used a lower temperature and if we had not used any yeast at all, we could have followed the curve exactly; it would have been very easy, it would have been just a question of physics. We would have done it perfectly, of course, if we stopped the yeast growth; the more we stopped the yeast growth the easier it would be to follow this really absurd curve, from the point of view of the yeast manufacturer. Dr. Free agreed with me—I do not hesitate to say it, because he said it was this morning ridiculous, something to that effect. It isn't growing yeast at all, it is just filling sugar into a vat.

XQ. 710. Does the amount of yeast propagation, that is, the multiplication of the yeast depend upon the amount of the seed yeast employed?

A. Well, of course, it is one of the factors.

The amount of seed yeast has an effect upon the rate of feed. The more yeast you have growing there the faster the growth will take place.

XQ. 712. How much seed yeast did you employ in these experiments?

A. I think those are given right on the exhibits, Mr. Philbin. 20 per cent. of molasses is the amount of seed yeast employed in the operation of Plaintiff's Exhibit 28.

The Hayduck '105 patent does not say anything with respect to the amount of seed yeast to be employed.

RE-DIRECT EXAMINATION BY MR. WATSON:

RDQ. 715. I understand that Dr. Free has already stated in the record that 20 per cent. of seed yeast is the normal conventional quantity. Do you agree with that?

A. Yes.

RDQ. 716. In your tests of these runs shown in Plaintiff's Exhibits 27 and 28 were the conditions of temperature of nutrient solution employed or aeration and other conditions used, except the rate of feed of course and the Ballings attained,—were these other conditions normal, conventional, standard, desirable conditions?

A. They were.

RDQ. 717. And well known in the art?

A. Yes.

RDQ. 718. If you had used a nutrient solution having a lower percentage of solids, unfermentable solids, how would that have affected the necessary rate of feed to arrive at these Ballings on the curve, would it have required faster feed or slower?

A. Slower feed—just a moment, a lesser amount. It would have required a faster feed.

MR. WATSON: That is all.

SIDNEY KAHN, called and sworn for the plaintiff in rebuttal, testified as follows:

DIRECT EXAMINATION BY MR. JOHNSON:

THE WITNESS: My name is Sidney Kahn, Baltimore, Maryland. I am vice-president of the Federal Yeast Corporation. I have been with the Federal Yeast Corporation since April, 1925.

Q. 3. In your association with the Federal Yeast Corporation were you familiar with the Zulauf process used by that company at the time it was sued for infringement of the Hayduck patents here in suit, '105 and '106, such as typified, for example, by mash sheet No. 1901, which is a part of the record that is going to be introduced here as a physical exhibit?

A. Yes, I was acquainted with that.

Q. 4. I hand you, merely to refresh your recollection, if you need it, a copy of that mash sheet and ask you if in that process the Federal Company prepared a dilute nutrient solution in the fermenter and seeded it with stock yeast, and if so, what was the Balling of that dilute nutrient solution?

A. The Balling of this solution at the start was .8.

Q. 5. And during that manufacturing process is it not a fact that the Federal Company added to the fermenter a more concentrated solution of what is called peptone wort on the left-hand side, and a more concentrated solution of what is called sugar wort, on the right-hand side?

A. Yes.

Q. 6. Indicated on that flow sheet?

A. That is true.

Q. 7. What was the mean Balling of that process approximately, the mean Balling of the solution originally in the fermenter and of the solutions added to the fermenter during the propagating process?

A. The Balling started at .8. The Balling of the concentrated wort—I don't see it on here—was 36; it was added. That is, the sugar wort.

The Balling of the peptone wort is shown there. That was 6.

Q. 10. And do you remember the volumes of those concentrated worts and the dilute wort in the fermenter sufficiently to tell me what the mean Balling of the three worts was?

A. Yes, I can give you an approximate figure. It ran between 3.5 and 4, the average of the worts.

Q. 11. Did you hear Dr. Free's testimony, given at the request of the Court, regarding this so-called 3 to 5 rule in the patent '105 in suit?

A. I heard part of it. I don't know whether——

Q. 12. Did you hear the part in which he gave his version as the 3 to 5 meaning the Balling in the fermenter as typified by the curves comprising Plaintiff's Exhibit 26?

A. Well, I heard part of that, that part pertaining to the average 3 to 5 during fermentation. I don't know whether it applies to those curves.

Q. 13. That is what I had in mind. And did you hear his testimony in which he spoke of another possible interpretation of the disputed sentence, in which he said on record page 536: "Now, it would be of no meaning and no practical interest or value to prescribe the arithmetical mean of the solutions concerned."

A. Yes, I heard that. I do not agree with that statement.

My understanding of that is definitely that the amount of materials used in each fermenter must have that average Balling before they are used. They may not be mixed together, but the average Balling of the amount of materials used should be between 3 and 5.

Q. 16. And in practicing this process, in the Federal Yeast Corporation, before you were enjoined from

so doing, did you make such a computation in order to determine how much mash materials you should use to run your factory?

A. Yes, we did.

CROSS-EXAMINATION BY MR. PHILBIN:

XQ. 18. As I understand it, you testified to the meaning of the 3 to 5 clause or sentence in the Hayduck '105 patent. Have you read that patent?

A. Yes.

XQ. 19. Was your interpretation of that sentence based upon that sentence alone or upon that sentence when read with the remainder of the patent?

A. My interpretation of that sentence is based on my general interpretation of the patent. It speaks——

THE COURT: What were you going to say?

THE WITNESS: It speaks about two different worts being employed of different densities.

THE COURT: What are they?

THE WITNESS: The first wort is diluted to 1 in the fermenter, the other wort is fed in after dilution, and——

THE COURT: That is the 12?

THE WITNESS: That is the 12 degree Balling, yes. And my understanding of that is that gives one a very definite way of calculating how much materials are to be used in that fermenter.

XQ. 20. Does the Hayduck '105 patent refer to a prior process disclosed in a Rainer patent of keeping the concentration of the sugar very low and preventing the formation of alcohol?

MR. JOHNSON: I object to that, your Honor, as being outside of the direct examination. This gentleman is called as a practical yeast manufacturer, not as a patent expert.

MR. PHILBIN: He was asked on direct examination as to the meaning of these things.

THE COURT: Well, he has testified that the testimony he has given us here is based upon his reading of the patent. We would like to know what his reading is.

MR. JOHNSON: No reference was made by the witness on direct examination to the patent whatever, your Honor.

THE COURT: Well, he has told us on cross-examination that his testimony is based upon his interpretation of this patent.

MR. JOHNSON: I have no objection if Mr. Philbin wants to make him his witness.

MR. PHILBIN: This is cross-examination.

(Question repeated by the reporter.)

A. That is mentioned in the patent, yes, but I don't think——

XQ. 21. That answers the question. Does the Hayduck patent also refer to a "high dilution" in connection with the Rainer patent?

A. It refers to a high dilution; I don't see just exactly the connection between the Rainer patent. "However, the increase in operating costs connected with this high dilution is partly compensated for by the advantage of the high yield."

XQ. 22. Dr. Lamb testified that the high dilution or low concentration of sugar in the Rainer patent was about 1 degree Balling. Does the Hayduck patent state that he intends to accomplish "the goal of obtaining a high yeast yield with little or no formation of alcohol" . . . "by the use of worts of normal quality and concentration"?

A. Yes, he uses worts of normal quality and normal concentration, but that does not say that that is in the actual fermentation.

XQ. 23. Dr. Lamb also testified that at the time of the Hayduck patent worts of normal concentration were from 3 to 5 degrees Balling. Have you any opinion on that or do you know what, at the time of Hayduck, were worts of normal concentration?

A. I believe that worts of normal concentration were straight-set mash and ran as high as 12, if that is your question. That, I believe, is the normal wort in straight-set mash.

XQ. 24. Do you agree with Dr. Lamb that at the time of Hayduck there were worts of normal concentration having 3 degrees to 5 degrees Balling or do you not know?

A. I really don't know what type of a mash you are referring to.

XQ. 25. Well, if at the time of Hayduck worts of from 3 to 5 degrees were normal concentration, doesn't the patent state that that is the kind of worts that Hayduck proposes to employ?

A. Well, what would be normal for a straight-set mash may not be normal for a mash of this type, as I understand it.

XQ. 26. Is there anything in the patent which says that "worts of normal quality and concentration" apply to a straight set mash and not to the kind of mash that Hayduck is proposing to use?

A. Well, there is something in the patent here which states that the normal concentration starts at 1 degree, or at least that the wort is diluted to 1 degree to start the fermentation.

XQ. 27. Is there anywhere a statement in this patent that a wort of 1 degree is of normal concentration?

A. No, there is nothing stating that 1 degree is the normal concentration. I don't see where it says that any particular concentration is normal. I don't know just what you mean by that.

XQ. 28. You do not know what is meant by the statement "a wort of normal concentration"?

A. Normal for what purpose? I don't understand it, no, I really do not.

XQ. 29. Will you read the first paragraph of page 1, lines 54 to 63, in which Hayduck is describing what his invention is and what kind of worts he proposes to employ, and then tell us whether you know what is meant by "worts of normal quality and concentration"?

MR. WATSON: If the Court please, the inquiries are very clearly and very obviously going entirely outside the direct examination of the witness.

THE COURT: Well, I assume he is doing it for the purpose of testing the credibility of the witness.

MR. WATSON: Is that the purpose, Mr. Philbin?

MR. PHILBIN: The purpose is of testing the knowledge of the witness with respect to what he has testified, and his qualification to speak as a patent expert, which he has done regarding——

THE COURT: Well, don't you think you have gone far enough with that?

MR. PHILBIN: I beg your pardon?

THE COURT: Do you still want to go further?

MR. PHILBIN: No, I don't think so.

THE WITNESS: I might say, your Honor, that my understanding of a normal wort in our particular mash here was 36 degrees Balling. We

used 36 in the concentrated form. We didn't use——

THE COURT: You are speaking now of your experience, when you say that?

THE WITNESS: Yes, that is right.

THE COURT: Very good. That is all.

XQ. 30. Now, you spoke of your practical experience in manufacturing yeast. When you commence a particular process of manufacturing for a certain number of fermenter tanks, what is the first thing you decide upon? Is it the amount of raw materials you are going to use, or the amount of yeast you are going to produce?

A. The first thing that we decide is to know how much yeast we want to make. The next thing is to calculate how much material to use in each unit volume of fermenters.

XQ. 32. Does that amount of materials differ when you use molasses or grains or mixed molasses and grains?

A. There would be a certain definite range of amount of material to be used if we were using only molasses. There would be a certain definite range of materials if we were using only grain. And those amounts are easily calculated, depending upon the fermenter volume or the production that we want to make.

XQ. 33. Then what is the next thing that you do, after you decide how much yeast you are going to make and what materials and the quantities you are going to employ?

A. The next thing to decide is how much of the materials are to be used in every fermenter, in order to have an optimum or at least a condition in that fermenter which will give us practical results, not having too much yeast grown and not having too little yeast grown.

The temperature has something to do with the amount of materials used. After we have decided that, we know the unit of materials to use to produce a certain amount of yeast. We just simply multiply that by the number of units of yeast we want to make and use that material, that amount of material.

MR. PHILBIN: That is all.

MR. JOHNSON: No re-direct, your Honor.

If your Honor please, there is only one thing left and that is for counsel to agree on the typical prices of various raw materials for as many years back as we can go prior to the patents in suit, and we have been unable to do that as yet. Mr. Philbin says he thinks we can agree, and then the plaintiff will put in an exhibit showing that table.

THE COURT: Then as I understand it, subject to the taking of further testimony on this one point, the case is closed on both sides.

MR. JOHNSON: There will be no further testimony taken. We will agree on the prices.

Case Closed.

MEMORANDUM.

(Filed October 29, 1937.)

Appearances:

ALEXANDER T. SCHENCK, Esq., solicitor for plaintiff;

MESSRS. WATSON, BRISTOL, JOHNSON & LEAVENWORTH, by L. A. WATSON, Esq., and C. V. JOHNSON, Esq., of counsel;

MESSRS. WINNE & BANTA, by JOHN A. CHRISTIE, Esq., solicitors for defendant;

MESSRS. FISH, RICHARDSON & NEAVE, by STEPHEN H. PHILBIN, Esq., and PAUL R. AMES, Esq., of counsel.

FAKE, *District Judge.*

In this suit the plaintiff seeks injunctive relief and accounting for the alleged infringement of five patents. The defendant attacks the validity of the patents and denies infringement. The subject matter is the production of yeast. The patents bearing thereon and involved in this suit are: Hayduck No. 1,449,103; Hayduck No. 1,449,105; Hayduck No. 1,449,106; Hayduck No. 1,449,109; and Corby et al. No. 1,673,735. These patents will be considered in sequence as above set out.

HAYDUCK No. 1,449,103.

This patent was before the District Court of Maryland in Fleischmann Yeast Company v. Federal Yeast Corporation, 8 Fed. (2d) 186, and there adjudicated valid and infringed, and on appeal the conclusions of the District Court were affirmed in 13 Fed. (2d) 570. All of the issues raised there are again raised here with certain additions. A study of the opinions in the foregoing cases coupled with a study of the prior state of the art, including the additional matter introduced

here, again leads to the conclusion that this patent is valid for the reasons set forth in the aforesaid opinions, and nothing which has been introduced here tends to change that result.

The question of infringement will now be considered. It was conceded at the trial that the use of aqua ammonia by the defendant constitutes an infringement if the patent is valid, and having found the patent valid, it follows that defendant infringes in that particular use. This still leaves open for adjudication here the question of defendant's infringement in the use of ammonium lactate and di-ammonium phosphate.

Looking to claims 1, 2, 3 and 4 of this patent, it is found that the patentee teaches the use of "an innocuous antacid substance" to neutralize the deleterious excess of acidity formed in the process of manufacture of yeast; that such antacid shall be added during propagation, and shall be of such a nature as to supply yeast-assimilable nitrogen to the yeast. Is ammonium lactate such a substance, or does it operate as an antacid when used in the defendant's process of propagation?

As to the substance known as ammonium lactate, plaintiff's expert among other things testified as follows:

"Q. . . . When that solution containing the ammonium lactate is put in the fermenter, is the solution acid?

"A. It is in general acid." . . .

It follows, of course, that if it is an acid, it is not antacid. As to whether or not the use of this substance by the defendant operates as an antacid in reducing the excess of acidity in the wort, plaintiff's Exhibits 13, 14 and 15, being defendant's mash sheets, disclose the defendant's operations and show as a whole an increase and not a decrease of acidity as the ammonium lactate

is added to the propagating tank. Taking this evidence and weighing the same in connection with other evidence bearing upon the point, it is clear that the defendant does not infringe this patent in the use of ammonium lactate.

The question must now be answered as to whether or not di-ammonium phosphate is an antacid and whether or not its use by the defendant operates as such in defendant's process of propagation. The ammonia content in di-ammonium phosphate is an antacid and the phosphate is an acid. As to whether then these substances when combined as di-ammonium phosphate operate in defendant's process as an antacid depends upon whether the yeast consumes more of the ammonia content or more of the phosphate content. In this connection, six of defendant's mash sheets were offered in evidence. They show some thirty additions of di-ammonium phosphate, ten of which indicated an increase of acidity, fourteen showed no change in acidity, and six indicated a decrease in acidity but these decreases were slight. This leads to the conclusion that the di-ammonium phosphate which defendant uses in the course of propagation is fed in not for the purpose of correcting an excess of acidity but rather as a yeast nutrient and as such its use was old in the art. In so far as its use happens to correct the excess of acidity, the amount of correction involved is so small and unimportant that the conclusion must be reached that the correction of acidity is a mere incident to the use of the di-ammonium phosphate as a nutrient.

This patent is not intended to cover nor does it cover all antacid substances. It covers only those innocuous substances which when used neutralize the deleterious excess of acidity in the wort. It, therefore, follows that the defendant does not infringe in its use of di-ammonium phosphate.

HAYDUCK No. 1,449,105.

Dealing with this patent, in the case of Standard Brands v. Federal Yeast Corporation, 38 Fed. (2d) 329, the Court held among other things as follows at page 337:

> . . . "it appears that certain of the features of patent '105, taken separately, were known to the prior art. The division of the wort into two parts, the beginning of propagation in one part, which had been diluted, and the addition of the other part continuously or at intervals, the restriction of alcohol production by regulating the supply of sugar—these several suggestions may be gathered together from the literature. But no publication shows the combination of elements found in claims 4 and 10 of the patent. These claims contain not merely the negative admonition that the sugar material be not fed too fast to the growing yeast. They indicate, when considered in the light of the specification, a process wherein the yeast is constantly given new supplies of all necessary nutriment by a continuous addition, so that there is always a wort concentration for the efficacious growth. The regulation of the rate of addition so that the yeast may propagate and substantially all the alcohol formed may be assimilated, and the maintenance of substantial constancy of concentration of nutriment, through regulation of the rate of addition, are not found in any reference in combination with the other elements expressed in these claims."

The foregoing indicates that the Court was of the opinion that claims 4 and 10 of the patent, when read in the light of the specification, teach a process of regulation, wherein the rate of addition of reserved materials to feed the growing yeast is made clear and certain. In the instant suit, issue is sharply joined on this point, the plaintiff asserting that the said claims and specification do instruct definitely as to the rate, while the defendant urges to the contrary.

The facts and arguments presented here differ very materially from those which were presented in the Maryland case. Here much emphasis has been laid upon the intent and meaning of the specification found in lines 90 to 95 inclusive, plaintiff contending that these lines illuminate the claims thereby furnishing instructions as to the rate of feed to be supplied to the growing mash. Claim 4 of the patent, being typical as to this point, reads as follows:

> "substantially continuously adding during the period of propagation, a wort of higher concentration, at a rate such that the yeast may propagate and substantially all of the alcohol which may be formed is assimilated by the yeast."

This claim, standing alone, is indefinite, vague, and uncertain as to the rate involved. It, in effect, directs the reader to experiment and find out for himself by methods of trial and error, if he can, just what the rate ought to be to produce the assimilation of alcohol as claimed. This then leads to an examination of the specification for the purpose of ascertaining whether or not it casts sufficient light on the claims so that one skilled in the art could with some degree of certainty work out the rate by mathematical calculation. Lines 64 to 95 of the specification read as follows:

> "The process may be, for example, executed in the following manner:
>
> "A wort adapted for yeast propagation (having, for example, a gravity of 12° Balling) is prepared according to the procedure commonly followed in the compressed yeast industry. A part of this wort is placed in the fermenting vat and is highly diluted (for example, to about 1° Balling), yeast is added thereto and it is aerated. Thereupon the remainder of the concentrated wort is added slowly and substantially continuously throughout a protracted period of time and at a

rate such that not only the alcohol which may have been formed from the quantity of sugar present in the diluted portion of the wort, but also any alcohol which may be formed from the sugar which is present in the added wort, can be assimilated immediately by the yeast. If arrangements are made to carry on the aeration process for ten hours, the addition of the wort may be effected for about seven to eight hours under continuous aeration and the aeration may be subsequently continued for two to three hours without the addition of any wort. *The quantity of the diluted wort which is originally available for the yeast is so chosen, for example, that the mean content of the entire wort employed would be 3° to 5° Balling.*"

The above specification when analyzed may be briefly summarized as follows:

(1) Prepare a wort of 12° Balling.

(2) Take a quantity of the 12° Balling and dilute it to 1° Balling.

(3) Put the diluted 1° Balling in a fermenting vat.

(4) Put seed yeast in the fermenting vat with the 1° Balling and aerate.

(5) Feed from the remaining 12° Balling into the fermenting vat wherein the 1° Balling and seed yeast are working.

As to the foregoing five points, the parties to this suit seem in full accord. The question arises, however, as to what rate the 12° Balling shall be fed into the fermenting vat as indicated by (5) above. Referring to the specification, it is found that it must be "added slowly and substantially continuously" and the rate of feeding or adding the same should be "such that not only the alcohol which may have been formed" from the sugar in the diluted portion in the fermenting

vat but also any alcohol present in the 12° Balling as added can be assimilated immediately by the yeast. It is obvious that thus far nothing specific is disclosed as to the rate at which the 12° Balling is to be fed into the fermenting vat. True, it directs that it shall be at that rate which will permit the immediate assimilation of the alcohol by the yeast but it leaves the inquirer to experiment and by trial and error find out for himself what the rate may be. Bearing in mind that a full and complete disclosure is now being sought as to the rate, attention is directed to lines 90 to 95 inclusive, of the specification which are above underlined. Do these lines disclose to one skilled in the art the necessary factors upon which the rate and quantity involved may readily be calculated? Is the meaning clear and unambiguous? A large part of the record and argument on this patent has revolved about these two questions.

Plaintiff's leading witness, a prominent chemist and expert, testified that the lines 90 to 95 in the specification, when read in the light of other language in the specification, direct the making of the 12° wort; the removal of a quantity thereof and the reducing of the same to 1° Balling by the addition of water and the placing of this diluted quantity in a fermenting vat, then the adding of the 12° wort to the diluted quantity until the same rises from 1° Balling to from 3° to 5° Balling. This was demonstrated by an experiment before the Court. The witness then further testified that the rule he deducted from the specification as well as the experiment before the Court related only to solutions before any yeast whatever had been grown therein.

Defendant's leading witness, a prominent chemist and expert, who was also qualified as a practical yeast manufacturer, testified that the instructions con-

tained in the specification as bearing upon the 3° to 5° Balling teach the maintaining of a 3° to 5° Balling in the wort employed, and that the said Balling could be maintained only by tests made during the process of manufacture. He further testified that the rate of feed from the 12° Balling wort would vary, depending upon the kind of materials employed. Thus is disclosed a sharp conflict between the parties as to what the claims when read with the specification actually disclose.

My conclusion is that claims 4 and 10, when read in the light of the specification, are vague and uncertain, even when read and studied by those who are expert and skilled in the art.

In Chemical Rubber Co. v. Raymond Rubber Co., 71 Fed. (C. C. A. 3) 179, a quotation appears from Consolidated Electric Light Co. v. McKeesport Light Co., 159 U. S. 465, 474, as follows:

> "If the description be so vague and uncertain that no one can tell, except by independent experiments, how to construct the patented device, the patent is void."

Again in Krupp v. Midvale, 191 Fed. (C. C. A. 3), 588, 602, the following appears:

> . . . "In other words, the teaching of the specification and the disclosure by the patentee must be such that, after the patent has expired, a user thereof shall not be left to the blind groping of experimental work, but by the plain teaching of the specification be enabled to use the process with certainty." . . .

See also George K. Hale Mfg. Co. v. Hafleigh & Co., 52 Fed. (2d) 714, a case in this circuit wherein Judge Kirkpatrick ruled as follows:

> "There must be hundreds of shades of blue, possibly thousands, and there is no indication of

what shades require this combination of ingredients. Further, there is nothing to indicate the proportions to be used. The most extensive experimentation would be necessary before it could be determined what blue dye-stuffs in what proportions would produce a commercial result. The law is clear that such a disclosure will not support a valid claim."

Again in Health Products Corp. v. Ex-Lax Mfg. Co. Inc., 22 Fed. (2d) (C. C. A. 2) 286, 287:

> "It is scarcely necessary to labor the principle that specifications must be more than a suggestion for promising experiment, hit or miss. They must contain complete directions, leading with certainty to the result."

See also Hebe Co. v. Enz, 283 Fed. (C. C. A. 7), 977, 978; De Lamar v. De Lamar Min. Co. 117 Fed. (C. C. A. 9) 240, 247; Finley v. McDouglad Const. Co., 28 Fed. (2d) (C. C. A. 5), 674, 675.

In the light of the foregoing citations and the evidence produced here bearing upon the validity of the patent, and also considering the differences between the record here and the record in the Maryland court, I can come to no other conclusion than that the Hayduck Patent 1,449,105 is invalid.

HAYDUCK No. 1,449,106.

The claims of this patent cover the neutralization of deleterious acidity as disclosed in the claims of Hayduck No. 1,449,103 bearing upon the propagation of yeast coupling the same with the rate of feeding as covered by Hayduck No. 1,449,105. Having hereinbefore found the last mentioned patent invalid, its combination with a valid patent adds nothing to the art. This patent is therefore invalid.

HAYDUCK No. 1,449,109.

In substance this patent covers the same field as those hereinbefore considered. Its disclosure of the use of a nitrogenous neutralizing agent adds nothing to the art since Hayduck No. 1,449,103 makes that disclosure. It is therefore invalid.

CORBY ET AL. No. 1,673,735.

This patent makes disclosures similar to those found in Hayduck No. 1,449,105 and Hayduck No. 1,449,106. The gist of the additional teaching found therein is the periodic withdrawal during propagation of a portion of the yeast containing liquid from the fermenter, diluting the residue left in the fermenter and restoring the starting conditions therein, thereby increasing the productive capacity of the fermenter. This contemplates a harvesting of a portion of the yeast crop as and when it ripens and the planting of a new crop in the area vacated. It amounts to no more than the exercise of the ordinary skill to be expected of those versed in the art. The idea is as old as the harvesting of agricultural crops when they ripen and the reseeding of the area thus vacated. The patent is invalid for want of patentable novelty.

DECREE.

(Filed November 30, 1937.)

This cause came on to be heard at this term, and was argued by counsel, and thereupon, upon consideration thereof, it is ORDERED, ADJUDGED and DECREED, as follows:

1. That the plaintiff is the owner of the Hayduck Patents Nos. 1,449,103, 1,449,105, 1,449,106 and 1,449,109, each of which was issued March 20, 1923, and the Corby et al. Patent No. 1,673,735, issued June 12, 1928, together with such rights, if any, as there may be, to recover under said patents.

2 (a) That claims 1 to 4 and 7 to 15, inclusive, of Hayduck Patent No. 1,449,103 are valid.

(b) That said claims were infringed by defendant in its operations of September 12 to 15, 1931, in which operations defendant used as raw materials cereal material, aqua ammonia, molasses and inorganic ammonium salts, namely, ammonium phosphate and ammonium sulfate. In these operations, there was a preliminary souring treatment, the cereal material being soured with lactic acid bacteria, producing lactic acid. This treatment was preliminary to the use of the cereal materials during the propagation of the yeast in the propagating vats. No aqua ammonia was used during the preliminary souring treatment. About seven pounds of aqua ammonia per thousand pounds of combined cereals and molasses used, were added to the reserve wort and converted to ammonium lactate, prior to propagation.

In the additions of aqua ammonia before propagation, the aqua ammonia reacted with a portion of the lactic acid to form ammonium lactate, the amount of aqua ammonia being insufficient to neutralize all of

the lactic acid and leaving an acid solution, which was subsequently fed with the reserve wort into the propagating vats at the rates shown in the mash sheets.

About eight pounds of aqua ammonia per thousand pounds of combined cereals and molasses were added directly to the propagating vat during the propagation. This addition effected a neutralization of deleterious acidity released from an inorganic ammonium salt in the yeast propagating vat.

The ammonium sulfate used was about twenty-three pounds per thousand pounds of combined cereals and molasses used. The mono ammonium phosphate used was about seventeen pounds per thousand pounds of combined cereals and molasses used.

(c) That said claims were not infringed by defendant in its operations of April 25 to 27, 1931, in which operations defendant used as raw materials cereal material, aqua ammonia, molasses and inorganic ammonium salts, namely, ammonium phosphate and ammonium sulfate. In these operations, there was a preliminary souring treatment, the cereal material being soured with lactic acid bacteria, producing lactic acid. This treatment was preliminary to the use of the cereal materials during the propagation of the yeast in the propagating vats. Aqua ammonia was added during the preliminary souring treatment only, about twenty pounds of aqua ammonia being added per thousand pounds of combined cereals and molasses used, which aqua ammonia was converted to ammonium lactate. In the additions of aqua ammonia before propagation, the aqua ammonia reacted with a portion of the lactic acid to form ammonium lactate, the amount of aqua ammonia being insufficient to neutralize all of the lactic acid and leaving an acid solution, which was subsequently fed with the reserve wort into the propagating vats at the rates shown in the mash sheets.

The ammonium sulfate used was about twenty pounds per thousand pounds of combined cereals and molasses used. The mono-ammonium phosphate used was about eighteen pounds per thousand pounds of combined cereals and molasses used.

In this operation, there was no aqua ammonia added to the propagating vat and the addition to the propagating vat of an acid solution containing lactic acid and ammonium lactate did not neutralize deleterious acidity.

(d) That said claims were not infringed by defendant in its operations of December 7 to 9, 1932, in which operations defendant used as raw materials cereal material, aqua ammonia, molasses and inorganic ammonium salts, namely, ammonium phosphate and ammonium sulfate. In these operations, there was a preliminary souring treatment, the cereal material being soured with lactic acid bacteria, producing lactic acid. This treatment was preliminary to the use of the cereal materials during the propagation of the yeast in the propagating vats. Aqua ammonia was added during the preliminary souring treatment only, about sixteen pounds of aqua ammonia being added per thousand pounds of combined cereals and molasses used, which aqua ammonia was converted to ammonium lactate. In the additions of aqua ammonia before propagation, the aqua ammonia reacted with a portion of the lactic acid to form ammonium lactate, the amount of aqua ammonia being insufficient to neutralize all of the lactic acid and leaving an acid solution, which was subsequently fed with the reserve wort into the propagating vats at the rates shown in the mash sheets. During propagation, several additions of diammonium phosphate were made to the propagating vats, the total amounting to about fourteen pounds per thousand pounds of combined cereals and molasses

used. The ammonium sulfate used was about twenty pounds per thousand pounds of combined cereals and molasses used. The mono-ammonium phosphate used was about eight pounds per thousand pounds of combined cereals and molasses used.

In this operation, there was no aqua ammonia added to the propagating vat, and the addition of diammonium phosphate did not neutralize deleterious acidity.

3. That all the claims of Hayduck Patent No. 1,449,105 are invalid.

4. That claims 1, 3, 4, 5, 6, 8, 12, 13 and 15 of Hayduck Patent No. 1,449,106 are invalid.

5. That all the claims of Hayduck Patent No. 1,449,109 are invalid.

6. That claims 1, 5, 6, 10, 13, 14, 17, 18 and 21 of the Corby et al. patent are invalid.

7. That a perpetual injunction issue out of and under the seal of this Court directed to the defendant, National Grain Yeast Corporation, enjoining and restraining it, its officers, directors, servants, agents, clerks, employees and workmen, and all persons acting for, by or under it, and each of them, from directly or indirectly practicing the process of producing yeast described in the Hayduck Patent No. 1,449,103 and claimed in its claims 1 to 4, and 7 to 14 inclusive, and particularly the process of producing yeast exemplified by defendant's operations of September 12 to 15, 1931, as set forth in paragraph 2 (b) hereof, and from directly or indirectly making, using, selling, or causing to be made, used or sold the article of yeast described in said patent and claimed in product claim 15 thereof.

8. That plaintiff recover of the said defendant, National Grain Yeast Corporation, all of the profits,

gains and advantages which said defendant has derived, received, earned, made or saved by reason of said infringement of Hayduck Patent No. 1,449,103, and all damages which the plaintiff has sustained by reason of said infringement; and it is hereby referred to James D. Carpenter, Jr., Esq., as Special Master of this Court, to take and state an account of said profits, gains, damages and advantages and plaintiff's expenses incurred in attending the examination authorized by the order of this Court, dated on or about March 18, 1935, and to assess the same and report thereon, pursuant to the statutes and rules in such cases made and provided and pursuant to the orders of this Court.

9. That the bill of complaint as to the Hayduck Patents Nos. 1,449,105, 1,449,106 and 1,449,109 and the Corby et al. Patent No. 1,673,735 be and the same is hereby dismissed.

10. That in view of a stipulation between the parties relating thereto, no costs be taxed herein against either party in favor of the other at this time.

GUY L. FAKE,
United States District Judge.

November 30, 1937.

FINDINGS OF FACT AND CONCLUSIONS OF LAW.

(Filed November 30, 1937.)

A. FINDINGS OF FACT.

1. This is a patent suit for alleged infringement of the Hayduck Patents Nos. 1,449,103, 1,449,105, 1,449,106 and 1,449,109, and Corby et al. Patent No. 1,673,735, owned by the plaintiff. The plaintiff and the defendant are both manufacturers of yeast, and the patents relate to yeast manufacture.

2. (a) Hayduck Patent No. 1,449,103, claims 1 to 4, 7, 8, 12, 13, 14 and 15, was before the District Court of Maryland in *Fleischmann Yeast Corporation v. Federal Yeast Corporation,* 8 F. (2d) 186, and it was there adjudicated valid and infringed as to such claims, this adjudication being affirmed, 13 F. (2d) 570. The same claims are here in suit, and in addition claims 9, 10 and 11. It is found that the claims in suit here are valid, for the reasons set forth in the above opinions in that suit.

(b) As to infringement, defendant admitted that it had infringed claims in suit of this patent, if valid, by the use of a certain process and denied that defendant had infringed by the use of two other processes.

The first process involved the neutralization of deleterious acidity released from an inorganic ammonium salt in the yeast propagating vat, by the addition of aqua ammonia to the yeast propagating vat. Upon defendant's admission, this process is found to be an infringement.

The second process included the use of ammonium lactate, consisting of the addition of an acid solution containing lactic acid and ammonium lactate, a yeast food, to the yeast propagating vat containing an in-

organic ammonium salt. Defendant's mash sheets (Plaintiff's Exhibits 13, 14 and 15), showed that in defendant's operations there was, as a whole, an increase and not a decrease of acidity as the ammonium lactate was added to the propagating tank. It is found that this process was not an infringement.

The third process involved the use of di-ammonium phosphate, consisting of the addition of di-ammonium phosphate, a yeast food, to the yeast propagating vat containing an inorganic ammonium salt. In defendant's operations, some thirty additions to the propagating tank of di-ammonium phosphate resulted in ten instances of an increase in acidity, in fourteen instances of no change in acidity, and in six instances a slight decrease in acidity. The use of di-ammonium phosphate as a yeast nutrient was old in the art. Insofar as its use happened to correct the excess of acidity, such correction was small and unimportant and a mere incident to the use of the di-ammonium phosphate as a nutrient. It is found that this process was not an infringement.

3. Hayduck Patent No. 1,449,105. Claims 4, 8, 9 and 10 were held valid and infringed in *Standard Brands v. Federal Yeast Corporation*, 38 F. (2d) 329, by the District Court in Maryland. All ten claims of the patent are in suit here.

Claim 4 of the patent is typical on the matter of rate of feed, it providing for

> "substantially continuously adding during the period of propagation, a wort of higher concentration, at a rate such that the yeast may propagate and substantially all of the alcohol which may be formed is assimilated by the yeast."

Neither the claim nor the specification discloses anything specific as to the rate at which the wort of higher concentration is to be fed into the fermenting

vat to produce the assimilation of alcohol. The inquirer is left to experiment and by trial and error find out for himself what the rate may be. There was a sharp conflict between plaintiff's leading witness, Dr. Lamb, a prominent chemist and expert, and defendant's leading witness Dr. Rautenstrauch, a prominent chemist and expert, who was also qualified as a practical yeast manufacturer, and between the parties, as to what the claims when read with the specification actually disclosed.

All of the claims of this Hayduck patent are invalid, because the claims when read in the light of the specification are vague and uncertain.

4. Hayduck Patent No. 1,449,106 combines the rate of feeding, as covered by Hayduck Patent No. 1,449,105, with the neutralization of deleterious acidity as covered by Hayduck Patent No. 1,449,103. Such combination added nothing to the art, and claims 1, 3, 4, 5, 6, 8, 12, 13 and 15 of this patent are therefore invalid.

5. Hayduck Patent No. 1,449,109 combines the process of Patent 1,449,103, including neutralization, and the process of Patent 1,449,105, including regulated nutrient feed, with the additional factor of supplying a substance having an alkaline reaction and containing assimilable nitrogen, by feeding it into the fermenter during the propagating period. This patent adds nothing to the art, because it covers the same field as those hereinbefore considered, and its disclosure of the use of a nitrogenous neutralizing agent adds nothing to the same disclosure in Hayduck Patent No. 1,449,103. All of the claims of this patent are invalid.

6. Corby et al. No. 1,673,735 has a disclosure similar to those in Hayduck Patents Nos. 1,449,105 and 1,449,106, there being an additional teaching of a periodic withdrawal during propagation of a portion of

the yeast containing liquid from the fermenter, diluting the residue left in the fermenter and restoring the starting conditions therein, thereby increasing the productive capacity of the fermenter. This contemplates a harvesting of a portion of the yeast crop as and when it ripens and the planting of a new crop in the area vacated. It amounts to no more than the exercise of the ordinary skill to be expected of those versed in the art. The idea is as old as the harvesting of agricultural crops when they ripen and the reseeding of the area thus vacated. Claims 1, 5, 6, 10, 13, 14, 17, 18 and 21 of this patent are invalid for want of patentable novelty.

7. (a) The following references relied upon by defendant in the present case with respect to the feature in the patents of neutralization, were neither in evidence nor cited in the answers in either the first or the second *Federal Yeast* suits, viz.: Jacqueman, British Patent 21,011 (1896); Abstract, Henneberg article (1908); (J. Soc. Chem. Ind.); "American Distillers Review" (1914); Wilfert article (Presshefe Kunsthefe und Backpulver, 1890); and Brenner article (Centralblatt f. Bakt. 1914).

Polsky, British Patent 20,787 (1892) and Fritsche, Austrian Patent 45/4047 were not offered in evidence, but were cited in the answer in the second Federal Yeast suit.

Lavedan Patent 1,201,062 was pleaded in the first Federal Yeast suit, and Roth, French Patent 470,925 was pleaded in the second Federal Yeast suit, but neither patent was offered in evidence in either suit. The abstract of the Henneberg article states on its face that it is an abstract of the original complete Henneberg articles in Wochenschrift für Brauerei, which original articles were in both the Federal Yeast suits.

A study of this prior art, including the additional matter introduced here, leads to the conclusion that the

Hayduck Patent 1,449,103, is valid for the reasons set forth in the opinions in *Fleischmann Yeast Co. v. Federal Yeast Corp.*, 8 F. (2d) 186, 13 F. (2d) 570, and nothing which has been introduced here tends to change that result.

(b) All the references relied upon by defendant, with respect to the feature of so-called regulated feed in Hayduck Patents Nos. 1,449,105, 1,449,106 and 1,449,109, and the Corby et al. patent, were in evidence in the second *Federal Yeast* case, (38 F. (2d) 329) and of them the Rainer and Iwanowski references were also in evidence in the first *Federal Yeast* case.

B. CONCLUSIONS OF LAW.

1. The bill of complaint should be dismissed as to Hayduck Patents Nos. 1,449,105, 1,449,106 and 1,449,109 and Corby et al. Patent No. 1,673,735.

2. A writ of injunction and an accounting should issue with respect to Hayduck Patent No. 1,449,103, claims 1 to 4 and 7 to 15 inclusive.

3. That in view of a stipulation between the parties relating thereto, no costs should be taxed herein against either party in favor of the other at this time.

GUY L. FAKE,
United States District Judge.

November 30, 1937.

PLAINTIFF'S PETITION ON APPEAL.

(Filed November 30, 1937.)

To the Honorable Guy L. Fake, United States District Judge:

Plaintiff, Standard Brands Incorporated, feeling aggrieved by the interlocutory decree filed herein on the thirtieth day of November, 1937, hereby appeals from said decree and from each and every part thereof (except in so far as it holds U. S. Letters Patent 1,449,103 valid and infringed and directs an injunction and accounting and recovery) to the United States Circuit Court of Appeals for the Third Circuit, for the reasons set forth in the assignment of errors filed herewith; and prays that its appeal be allowed, that citation be issued as provided by law, and that a transcript of the record, proceedings, exhibits and papers upon which said decree was based, duly authenticated, be sent to the United States Circuit Court of Appeals for the Third Circuit.

WATSON, BRISTOL, JOHNSON & LEAVENWORTH,
Solicitors for Plaintiff.

Dated: November 30, 1937.

ORDER ALLOWING APPEAL.

(Filed November 30, 1937.)

ORDERED, that the appeal of the plaintiff from the interlocutory decree filed herein on the thirtieth day of November, 1937, be and hereby is allowed, and that security for costs on appeal be and hereby is fixed at the sum of two hundred fifty ($250) dollars.

GUY L. FAKE,
United States District Judge.

Dated: November 30, 1937.

PLAINTIFF'S ASSIGNMENTS OF ERROR.

(Filed November 30, 1937.)

To the Honorable Judges of the United States District Court for the District of New Jersey:

Now comes plaintiff, Standard Brands Incorporated, and assigns the following errors in the decree made and entered herein on November 30, 1937, upon which it will rely in the prosecution of its appeal from said decree, and asserts that the Court erred in the following respects, towit:

1. In holding that defendant's operations, typified by Plaintiff's Exhibits 14 and 15, do not infringe the issue claims 1-4 and 7-15 inclusive of Hayduck Patent 1,449,103.

2. In failing to hold that defendant's operations, typified by Plaintiff's Exhibits 14 and 15, infringe the issue claims 1-4 and 7-15 inclusive of Hayduck Patent 1,449,103.

3. In holding that all of the claims of Hayduck Patent 1,449,105 are invalid.

4. In failing to hold that all of the claims of Hayduck Patent 1,449,105 are valid and are infringed by each of defendant's operations typified by Plaintiff's Exhibits 13, 14 and 15.

5. In holding that the issue claims 1, 3, 4, 5, 6, 8, 12, 13 and 15 of Hayduck Patent 1,449,106 are invalid.

6. In failing to hold that the issue claims 1, 3, 4, 5, 6, 8, 12, 13 and 15 of Hayduck Patent 1,449,106 are valid and are infringed by each of defendant's operations typified by Plaintiff's Exhibits 13, 14 and 15.

7. In holding that all of the claims of Hayduck Patent 1,449,109 are invalid.

8. In failing to hold that all the claims of Hayduck Patent 1,449,109 are valid and are infringed by each of defendant's operations typified by Plaintiff's Exhibits 13, 14 and 15.

9. In holding that issue claims 1, 5, 6, 10, 13, 14, 17, 18 and 21 of the Corby et al. Patent 1,673,735 are invalid.

10. In failing to hold that the issue claims 1, 5, 6, 10, 13, 14, 17, 18 and 21 of the Corby et al. Patent 1,673,735 are valid and are infringed by defendant's operations typified by Plaintiff's Exhibit 15.

11. In holding that defendant's operations, typified by Plaintiff's Exhibits 13, 14 and 15 in so far as concerns the addition of ammonium lactate fed into the propagating vat along with the reserve solution, do not infringe the issue claims 1-4 and 7-15 inclusive of Hayduck Patent 1,449,103.

12. In failing to hold that defendant's use of ammonium lactate fed into the propagating vat along with a reserve solution in its operations, typified by Plaintiff's Exhibits 13, 14 and 15, infringes the issue claims 1-4 and 7-15 inclusive of Hayduck Patent 1,449,103.

13. In holding that the solution containing ammonium lactate which defendant feeds into the propagating vat along with the reserve nutrient solution in its operations typified by Plaintiff's Exhibits 13, 14 and 15 does not act as an antacid.

14. In failing to hold that the solution containing ammonium lactate which defendant feeds into the propagating vat, that is the reserve nutrient solution, in its operations typified by Plaintiff's Exhibits 13, 14 and 15 acts as an antacid to neutralize the deleterious excess of acidity released from inorganic ammonium salts in the propagating vat.

15. In holding that defendant's operations typified by Plaintiff's Exhibit 15, in so far as concerns the addition of di-ammonium phosphate to the propagating vat, do not infringe the issue claims 1-4 and 7-15 inclusive of Hayduck Patent 1,449,103.

16. In failing to hold that defendant's addition of di-ammonium phosphate to the propagating vat in its operations typified by Plaintiff's Exhibit 15 infringes the issue claims 1-4 and 7-15 inclusive of Hayduck Patent 1,449,103.

17. In holding that in defendant's operations typified by Plaintiff's Exhibit 15 the correction of acidity due to the use of di-ammonium phosphate is a mere incident to its use as a nutrient.

18. In failing to hold that in its operations typified by Plaintiff's Exhibit 15 defendant deliberately uses di-ammonium phosphate as an antacid to reduce excess acidity released in the propagating liquid from inorganic ammonium salts.

19. In holding that in so far as defendant's use of di-ammonium phosphate in the operations typified by Plaintiff's Exhibit 15 happens to correct excess acidity, the amount of correction involved is small and unimportant.

20. In failing to hold that defendant uses di-ammonium phosphate in its operations typified by Plaintiff's Exhibit 15 to reduce excess acidity to a marked and important extent.

21. In failing to hold that the figures appearing under the column headed "Acidity" in Plaintiff's Exhibit 15 show the titratable acidity just before and one hour after the additions of di-ammonium phosphate shown in the column headed "D" and do not show the acidity immediately after the additions of di-ammonium

phosphate; and that during the intervening hour additional inorg- .ic acid has been released from the ammonium sulphate as the yeast utilizes the nitrogen thereof in its growth.

22. In holding that as to Hayduck Patent 1,449,105 the facts and arguments presented in the instant case differ very materially from those presented as to the same patent in the case of Standard Brands v. Federal Yeast Corporation, 38 F. (2d) 329.

23. In holding that the disclosure of Hayduck Patent 1,449,105 is vague and uncertain as to the rate at which the reserve solution is to be fed into the fermenting vat and leaves the inquirer to experiment by trial and error to find out for himself what the rate ought to be.

24. In failing to hold that Hayduck Patent 1,449,105 discloses a complete and operative process in full compliance with R. S. 4888.

25. In holding that plaintiff's expert testified that lines 90-95 of page 1 of the specification of Hayduck Patent 1,449,105 direct the making of the 12 degree wort, the removal of a quantity thereof, the reducing of the same to 1 degree Bg. by the addition of water, the placing of this diluted quantity in a fermenting vat, and then the adding of the 12 degree wort to the diluted quantity until the same rises from 1 degree Bg. to from 3 degrees to 5 degrees Bg.

26. In failing to hold that lines 90-95 of page 1 of Hayduck Patent 1,449,105 instruct one skilled in the art how to determine by arithmetical computation how much concentrated solution shall be made up for use in a plant of any given capacity, what portion thereof shall be placed in the propagating vat, and how much water shall be used to dilute it initially to

about 1 degree Bg., so that the manufacturer can efficiently use his apparatus and produce the yeast within the time required; and that the accuracy of such arithmetical computations was demonstrated by plaintiff's expert in court.

27. In holding Hayduck Patent 1,449,106 invalid because it combines the processes of Hayduck Patents 1,449,103 and 1,449,105.

28. In holding that Hayduck Patent 1,449,109 covers in substance the same field as Hayduck Patents 1,449,103, 1,449,105 and 1,449,106.

29. In holding that the disclosure of Hayduck Patent 1,449,109 adds nothing to the art over Hayduck Patent 1,449,103.

30. In holding that the Corby et al. patent 1,673,735 merely contemplates a harvesting of a portion of the yeast crop as and when it ripens and the planting of a new crop in the area vacated.

31. In holding that the Corby et al. patent 1,673,735 amounts to no more than the exercise of the ordinary skill to be expected of those versed in the art.

32. In dismissing the bill of complaint as to Hayduck Patents 1,449,105, 1,449,106, 1,449,109 and Corby et al. Patent 1,673,735, and in not making a decree holding that plaintiff is entitled to all of the relief prayed for in the bill.

STANDARD BRANDS INCORPORATED,

By WATSON, BRISTOL, JOHNSON & LEAVENWORTH,

Its Solicitors.

PLAINTIFF'S CITATION ON APPEAL.

(Filed December 8, 1937.)

UNITED STATES OF AMERICA, *ss.:*

To National Grain Yeast Corporation,

GREETING:

You are hereby cited and admonished to be and appear in the United States Circuit Court of Appeals for the Third Circuit, to be held at the City of Philadelphia, State of Pennsylvania, on the thirtieth day of December, 1937, pursuant to an appeal filed and entered in the Clerk's Office of the District Court of the United States for the District of New Jersey, wherein Standard Brands Incorporated is plaintiff-appellant and you are defendant-appellee, to show cause, if any there be, why the interlocutory decree rendered against said appellant as in said petition on appeal mentioned, should not be corrected and why justice should not be done to the parties in that behalf.

WITNESS the HONORABLE GUY L. FAKE, United States District Judge for the District of New Jersey, this thirtieth day of November, 1937.

(Seal)

GUY L. FAKE,
United States District Judge.

DEFENDANT'S PETITION ON APPEAL.

(Filed December 20, 1937.)

To the Honorable Guy L. Fake, Judge of the District Court of the United States for the District of New Jersey:

The above-named defendant, National Grain Yeast Corporation, feeling itself aggrieved by the interlocutory decree entered in this court in the above-entitled cause on the thirtieth day of November, 1937, does hereby appeal to the United States Circuit Court of Appeals for the Third Circuit from so much of said decree as holds claims 1 to 4 and 7 to 15, inclusive, of United States Patent No. 1,449,103 valid and infringed, and as grants an injunction and as directs an accounting and a recovery by plaintiff, for the reasons set forth in the assignment of errors filed herewith, and prays that this appeal be allowed, that a citation be issued as provided by law, and that a transcript of the record, proceedings and exhibits upon which said decree was based, duly authenticated, be sent to the United States Circuit Court of Appeals for the Third Circuit, under the rules of said court in such cases made and provided.

NATIONAL GRAIN YEAST CORPORATION,

By WALTER G. WINNE,
Its Solicitor.

December 20, 1937.

ORDER ALLOWING APPEAL.

(Filed December 20, 1937.)

ORDERED that the appeal of the defendant from the interlocutory decree filed herein on the thirtieth day of November, 1937, be and hereby is allowed, and that security for costs on appeal be and hereby is fixed at the sum of two hundred and fifty dollars ($250).

GUY L. FAKE,
United States District Judge.

December 20, 1937.

DEFENDANT'S ASSIGNMENT OF ERRORS.

(Filed December 20, 1937.)

Now comes the defendant herein, National Grain Yeast Corporation, and files the following assignment of errors upon which it will rely in its prosecution of the appeal in the above-entitled cause from so much of the decree of this Honorable Court, entered on or about November 30, 1937, as holds claims 1 to 4 and 7 to 15, inclusive, of United States Patent No. 1,449,103 valid and infringed, and as grants an injunction and directs an accounting and a recovery by the plaintiff, and asserts that the Honorable Court erred in the following respects, to wit:

1. In holding that claims 1 to 4 and 7 to 15, inclusive, of Hayduck Patent No. 1,449,103, or any of them, are valid, and in failing to hold said claims and each of them to be invalid and void.

2. In holding that claims 1 to 4 and 7 to 15, inclusive, of Hayduck Patent No. 1,449,103, or any of them, are valid for the reasons set forth in the opinion in

the suit of Fleischmann Yeast Corporation v. Federal Yeast Corporation, 8 F. (2d) 186 and 13 F. (2d) 570, and that the prior state of the art, including and together with the additional matter introduced in this case, does not tend to change the conclusions arrived at in that case as to the validity of this patent.

3. In failing to hold that the alleged invention in the proposed neutralizing of too much acidity in a yeast wort did not rise to the dignity of invention.

4. In failing to hold that, prior to Hayduck's alleged invention claimed in Patent No. 1,449,103, the importance of obtaining and maintaining the proper amount of acidity during the propagation of yeast worts was fully appreciated.

5. In failing to hold that The American Distillers Review for 1914 (Vol. 4), the Wilfert article (Presshefe Kunsthefe and Backpulver, 1890) and the Molhant British Patent No. 11,617 of 1913 show that the importance of obtaining and maintaining the proper amount of acidity was fully appreciated prior to Hayduck's alleged invention.

6. In failing to hold that the prior art Pollak Swiss Patent No. 65,539 recognized and disclosed the neutralizing of excessive acidity in yeast manufacture.

7. In failing to hold that the alleged invention of neutralization of deleterious excessive acidity by means of ammonia or ammonium compounds was not a patentable invention over the prior disclosure of the neutralization of excessive acidity in a souring fermentation by means of ammonia or ammonium compounds, as in the Pollak Swiss Patent No. 65,539.

8. In failing to hold that it was well known prior to Hayduck's alleged invention to neutralize acidity injurious to the yeast during fermentation.

9. In failing to hold that it was known prior to Hayduck's alleged invention that inorganic ammonium salts were yeast nutrients and might produce harmful acidity and that Hayduck was not the first to know that ammonium salts might produce acidity which might be deleterious to the yeast.

10. In failing to hold that the prior art patents of Polsky British Patent No. 20,787 of 1892, Jacquemin British Patent No. 21,011 of 1896, Mohlant British Patent No. 11,617 of 1913 and Fritsche Austrian Patent No. 45/4047 disclose the process of employing sugar materials (sugar, grain, molasses) and inorganic ammonium salts and that no patentable invention would be involved in neutralizing injurious acidity resulting from the use of such inorganic ammonium salts.

11. In failing to hold that the Lavedan Patent No. 1,201,062 disclosed the use of ammonium salts as yeast nutrients in yeast manufacture.

12. In failing to hold that the Henneberg articles (J. Soc. Chem. Ind., 1908) disclosed that the acids in inorganic ammonium salts might be injurious to yeast and that, if so, such injurious action might be overcome by adding a compound capable of neutralizing such acids.

13. In failing to hold that the Brenner article (Centralblatt f. Bakt., 1914) shows that it was well known prior to Hayduck's alleged invention that inorganic ammonium salts are sources of assimilable nitrogen and that, if they release too much acidity, there should be neutralization.

14. In failing to hold that the principle of neutralizing deleterious acidity resulting from feeding inorganic ammonium salts was well understood prior to Hayduck's alleged invention and that Hayduck did not

make any new principle or discovery of such high quality as to justify a patent monopoly.

15. In failing to dismiss the bill of complaint as to Hayduck Patent No. 1,449,103.

16. In ordering an injunction and an accounting against the defendant.

17. In holding that plaintiff is entitled to recover its damages and defendant's profits, gains and advantages by reason of infringement of Hayduck Patent No. 1,449,103, and plaintiff's expenses incurred in attending the examination authorized by the order of this Court, dated on or about March 18, 1935.

WHEREFORE, the defendant prays that so much of said decree as held claims 1 to 4 and 7 to 15, inclusive of Letters Patent No. 1,449,103 valid and infringed, and as grants an injunction and directs an accounting and a recovery by the plaintiff, be reversed, and that the District Court of the United States for the District of New Jersey be instructed to enter a decree dismissing the bill of complaint with costs to the defendant.

NATIONAL GRAIN YEAST CORPORATION,
Defendant

By WALTER G. WINNE,
Solicitor for Defendant.

December 20, 1937.

DEFENDANT'S CITATION ON APPEAL.

(Filed January 3, 1938.)

UNITED STATES OF AMERICA, *ss.:*

To Standard Brands Incorporated,

GREETING:

You are hereby cited and admonished to be and appear in the United States Circuit Court of Appeals for the Third Circuit, to be held at the City of Philadelphia, State of Pennsylvania, on the twentieth day of January, 1938, pursuant to an appeal and an order allowing such appeal filed and entered in the clerk's office of the District Court of the United States for the District of New Jersey, in equity, wherein National Grain Yeast Corporation is defendant-appellant and you are plaintiff-appellee, to show cause, if any there be, why the interlocutory decree rendered against said appellant as in said appellant's petition on appeal and assignments of error mentioned, should not be corrected, and why speedy justice should not be done to the parties in that behalf.

WITNESS the HONORABLE GUY L. FAKE, United
(Seal) States District Judge for the District of New Jersey, this twentieth day of December, 1937.

GUY L. FAKE,
United States District Judge.

STIPULATED PRÆCIPE.

IN THE DISTRICT COURT OF THE UNITED STATES,
FOR THE DISTRICT OF NEW JERSEY.

IN EQUITY. No. 4552.

Standard Brands Incorporated,
Plaintiff,

v.

National Grain Yeast Corporation,
Defendant.

IT IS HEREBY STIPULATED by and between counsel for the respective parties that the printed transcript of record upon the appeals of both parties, in this cause, shall consist of the following matters:

1. The Docket Entries.

2. Bill of Complaint.

3. Answer, as amended.

(Print Answer as amended by amendments filed May 8, 1934, and August 20, 1935.)

4. Defendant's Motion for an Order Amending Answer and Reopening Proofs and Order thereon, filed March 2, 1936.

(Omit printing of Kamienski German Patent 269,192 and translation thereof with Motion and substitute note as follows: "Kamienski German Patent 269,192 in physical Exhibit D-2 and translation thereof in reproduced Exhibit D-1.")

5. Agreed Statement of Fact, submitted February 28, 1936.

6. Stipulation as to Prices of Certain Commodities and Defendant's Objection Thereto, filed December 22, 1937.

7. Condensed Statement of Evidence including Testimony of all witnesses reduced to narrative form and Exhibits, the Exhibits to be dealt with as follows:

(a) Exhibits to be reproduced in the transcript of record.

Plaintiff's Exhibits P-1 to P-5 and P-11 to P-28, all inclusive.

Defendant's Exhibits D-1 (including translation of Kamienski German Patent 269,192), D-3, D-5 (print only translation of "Certification" and specification with claims, pages 1, 2 and 3), D-6 (print only translation of patent), D-8 (1, 2, 3 and 4), D-9, D-9A to D-9H (inclusive) and D-10.

(b) Physical Exhibits.

Plaintiff's Exhibits P-6 to P-10 inclusive.

Defendant's Exhibits D-2 (including Kamienski German Patent 269,192), D-4, D-5, D-6, D-7 (1, 2, 3 and 4), and D-11.

8. Opinion.

9. Decree.

10. Findings of Fact and Conclusions of Law.

11. Plaintiff's Petition on Appeal and Order Allowing Same.

12. Plaintiff's Assignments of Error.

13. Plaintiff's Citation on Appeal.

14. Defendant's Petition on Appeal and Order Allowing Same.

15. Defendant's Assignments of Error.

16. Defendant's Citation on Appeal.

17. Order approving condensed statement of evidence as lodged.

18. This Præcipe and stipulation.

19. Stipulation and Order extending return day of citation.

20. Stipulation and order approving condensed statement of evidence.

21. Stipulation as to Record.

22. Clerk's Certificate.

IT IS FURTHER STIPULATED that all of the originals of the above reproduced exhibits and all of the above physical exhibits, both plaintiff's and defendant's, may be transmitted to the Circuit Court of Appeals for the Third Circuit and referred to if need arises.

IT IS FURTHER STIPULATED that notice of lodgment, as provided in Equity Rule 75, is hereby waived.

Dated: March 29, 1938.

WATSON, BRISTOL, JOHNSON & LEAVENWORTH,
Counsel for Plaintiff-Appellant.

Dated: March 29, 1938.

PAUL R. AMES,
Counsel for Defendant-Appellant.

STIPULATION AND ORDER.

(Filed April 22, 1938.)

IN THE UNITED STATES CIRCUIT COURT OF APPEALS,
FOR THE THIRD CIRCUIT.

No. 6651.

Standard Brands Incorporated,
Plaintiff-Appellant,

v.

National Grain Yeast Corporation,
Defendant-Appellant.

IT IS HEREBY STIPULATED AND AGREED, by and between counsel for the respective parties hereto, that the return days of the citations, the time for lodging and approving the narrative statement of the evidence, and the time for filing the transcript of record and docketing the appeals herein, in the United States Circuit Court of Appeals, are each and all hereby extended to and including the thirty-first day of May, 1938, and the term of this court is accordingly extended for the consideration of any matters which may arise herein.

Dated April 20, 1938.

WATSON, BRISTOL, JOHNSON & LEAVENWORTH,
Counsel for Plaintiff-Appellant.
PAUL R. AMES,
Counsel for Defendant-Appellant.

It is so ordered, April 22, 1938.

J. WARREN DAVIS,
United States Circuit Judge.

STIPULATION AND ORDER APPROVING CONDENSED STATEMENT OF EVIDENCE.

(Filed 1938.)

IT IS HEREBY STIPULATED AND AGREED, by and between counsel for the respective parties hereto, that the attached condensed statement of the evidence is true, complete and properly prepared, and that the same may become part of the record for the purposes of the appeal.

IT IS FURTHER STIPULATED AND AGREED that either party may refer to the original transcript of the record for correction of errors in the printed record on appeal, if such should appear.

CLAIR V. JOHNSON,
Of Counsel for Plaintiff-Appellant.

Dated June 1, 1938.

PAUL R. AMES,
Of Counsel for Defendant-Appellant.

Dated May 31, 1938.

It is so ordered.

GUY L. FAKE,
United States District Judge.

Dated

ORDER ASSIGNING HON. OLIVER B. DICKINSON AND HON. ALBERT B. MARIS FOR ARGUMENT.

(Filed June 9, 1938.)

IN THE UNITED STATES CIRCUIT COURT OF APPEALS,
FOR THE THIRD CIRCUIT.

No. 6651. March Term, 1938.

Standard Brands, Inc.,
Appellant;

v.

National Grain Yeast Corporation,
Appellee.

APPEAL FROM THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF NEW JERSEY.

And now, to wit: this ninth day of June, A. D. 1938, it is ordered that Hon. Oliver B. Dickinson, District Judge for the Eastern District of Pennsylvania, and Hon. Albert B. Maris, District Judge for the Eastern District of Pennsylvania, be, and they are hereby assigned to sit in above case in order to make a full court.

J. WARREN DAVIS,
Circuit Judge.

ORDER ASSIGNING HON. OLIVER B. DICKINSON AND HON. ALBERT B. MARIS FOR ARGUMENT.

(Filed June 9, 1938.)

IN THE UNITED STATES CIRCUIT COURT OF APPEALS,
FOR THE THIRD CIRCUIT.

No. 6670. March Term, 1938.

National Grain Yeast Corporation,
Appellant,

v.

Standard Brands, Inc.,
Appellee.

APPEAL FROM THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF NEW JERSEY.

And now, to wit: this ninth day of June, A. D. 1938, it is ordered that Hon. Oliver B. Dickinson, District Judge for the Eastern District of Pennsylvania, and Hon. Albert B. Maris, District Judge for the Eastern District of Pennsylvania, be, and they are hereby assigned to sit in above case in order to make a full court.

J. WARREN DAVIS,
Circuit Judge.

REFERENCE TO ARGUMENT.

IN THE UNITED STATES CIRCUIT COURT OF APPEALS,
FOR THE THIRD CIRCUIT.

No. 6651. March Term, 1938.

Standard Brands, Incorporated,
Plaintiff-Appellant,

v.

National Grain Yeast Corporation,
Defendant-Appellee.

No. 6670. March Term, 1938.

National Grain Yeast Corporation,
Defendant-Appellant,

v.

Standard Brands, Incorporated,
Plaintiff-Appellee.

And afterwards, to wit, the ninth day of June, 1938, come the parties aforesaid by their counsel aforesaid, and this case being called for argument sur pleadings and briefs, before the Honorable John Biggs, Jr., Circuit Judge, and Honorable Oliver B. Dickinson and Honorable Albert B. Maris, District Judges, and the Court not being fully advised in the premises, takes further time for the consideration thereof,

And afterwards to wit, on the first day of February, 1939, come the parties aforesaid by their counsel aforesaid, and the Court, now being fully advised in the premises, renders the following decision:

IN THE

UNITED STATES CIRCUIT COURT OF APPEALS,

FOR THE THIRD CIRCUIT.

No. 6651. March Term, 1938.

STANDARD BRANDS, INCORPORATED,
Plaintiff-Appellant,

v.

NATIONAL GRAIN YEAST CORPORATION,
Defendant-Appellee.

No. 6670. March Term, 1938.

NATIONAL GRAIN YEAST CORPORATION,
Defendant-Appellant,

v.

STANDARD BRANDS, INCORPORATED,
Plaintiff-Appellee.

APPEALS FROM THE DISTRICT COURT OF THE UNITED STATES, FOR THE DISTRICT OF NEW JERSEY.

OPINION.

(Filed February 1, 1939.)

Before BIGGS, *Circuit Judge,* and DICKINSON and MARIS, *District Judges.*

BIGGS, *Circuit Judge.*

There are two appeals in the case at bar. The original suit was brought by Standard Brands, Incorporated, plaintiff-appellant in No. 6651 and plaintiff-appellee in No. 6670.

v. National Grain Yeast Corporation, defendant-appellee in No. 6651 and defendant-appellant in No. 6670. For the sake of clarity in this opinion we will not make use of the words appellant and appellee but will refer to Standard Brands, Incorporated, and National Grain Yeast Corporation. The bill of complaint alleges that Friedrich Hayduck was the first, original and sole inventor of certain new and useful improvements in the process for the manufacture of compressed yeast and the product described and claimed in United States Patent No. 1,449,103, issued March 20, 1923, and that he was also the inventor of certain new and useful improvements in a low-alcohol yeast process described and claimed in United States Patents Nos. 1,449,105, 1,449,106 and 1,449,109, issued upon March 20, 1923; that Robert L. Corby and Wilhelm H. Bührig were the first, original and joint inventors of certain new and useful improvements in a process for the manufacture of yeast described and claimed by them in United States Patent No. 1,673,735, issued upon June 12, 1928; that all the rights of the named individuals in these respective patents were assigned to Standard Brands, Incorporated; and that National Grain Yeast Corporation has infringed and is now infringing these patents.

To the bill of complaint National Grain Yeast Corporation filed an answer denying the validity of the patents and denying infringement. We conceive that the questions presented may be disposed of most expeditiously by treating the patents separately, but before embarking upon this separate treatment we think that we should state that the learned District Judge found Hayduck Patent No. 1,449,103 to be valid and found it to be infringed by one of the processes used by National Grain Yeast Corporation which may be described for the sake of brevity as the aqua ammonia process. The District Judge found that Hayduck Patent No. 1,449,105 was invalid because of indefiniteness and therefore made no finding as to its infringement. He found that Hayduck Patent No. 1,449,106 was invalid because it con-

sisted of a combination of the processes disclosed by Hayduck No. 1,449,103 with Hayduck No. 1,449,105, and that since the latter patent was invalid its combination with a valid patent added nothing to the art of making yeast. The District Court made no finding as to infringement in respect to the patent last named. The District Judge also held that Hayduck Patent No. 1,449,109 was invalid in that it added nothing to the art beyond Hayduck No. 1,449,103, but made no finding as to the infringement of this patent. He held Corby and Bührig Patent No. 1,673,735 invalid for want of patentable novelty and made no finding as to its infringement.

Standard Brands, Incorporated, appeals from a decree of the District Court embodying the findings set forth in the previous paragraph of this opinion, except in so far as it holds Hayduck Patent No. 1,449,103 valid and infringed, grants an injunction and directs an accounting. National Grain Yeast Corporation appeals from that part of the decree of the District Court holding the claims in controversy of Hayduck Patent No. 1,449,103 to be valid and infringed, granting an injunction and directing an accounting and a recovery by Standard Brands, Incorporated. These appeals frame the issues before us.

For the purpose of brevity we will refer to the Hayduck patents hereafter by the last three numerals of the respective patent numbers. Hayduck -103 was held valid and infringed by the District Court of Maryland in Fleischmann Yeast Co. v. Federal Yeast Corporation, 8 F. (2d) 186, and this holding was affirmed by the Circuit Court of Appeals for the Fourth Circuit in 13 F. (2d) 570. Hayduck Patents -105 and -106 were held valid and infringed by the District Court of Maryland in Standard Brands, Incorporated, v. Federal Yeast Corporation, 38 F. (2d) 329. No appeal was taken to the Circuit Court of Appeals for the Fourth Circuit in the cited case.

Though these decisions are entitled to great weight the adjudications contained therein on the matters here in con-

troversy are not binding upon us, and our decision, as was that of the District Judge below, must be based upon our independent judgment upon the questions presented. New York Scaffolding Co. v. Liebel-Binney Co., 254 U. S. 24; Mast, Foos & Co. v. Stover Manufacturing Co., 177 U. S. 485; Sanitary Refrigerator Co. v. Winters, 280 U. S. 30.

As to Hayduck Patent No. 1,449,103.

Claims 1 to 4, inclusive, and 7 to 15, inclusive, of this patent are alleged to be infringed by National Grain Yeast Corporation. As we have stated, the learned District Judge held all of the claims referred to as valid. If they are valid one of the processes used by the National Grain Yeast Corporation, viz., the process which we have described heretofore as the aqua ammonia process, infringes the patent. The court below, referring to the decisions of the District Court of Maryland and that of the Circuit Court of Appeals for the Fourth Circuit, supra, stated, "A study of the opinions in the foregoing cases coupled with a study of the prior state of the art, including the additional matter introduced here, again leads to the conclusion that this patent is valid for the reasons set forth in the aforesaid opinions, and nothing which has been introduced here tends to change that result."

At this point we deem it necessary to make a brief statement of certain matters relating to the prior art. The art of manufacturing yeast is a very old one. Stating its principle in simplest terms, it consists of putting seed yeast into a nutrient solution which it devours and in which it propagates itself by budding. Yeast feeds upon sugar, making use of the carbon, nitrogen and other elements contained therein. Originally nutrient solutions were prepared by souring cereals with water in souring tanks, such cereals including corn, rye, barley and malt, all of which are organic materials as distinguished from inorganic materials. As the souring process continued in the souring tank and the materials contained therein tended to become homo-

geneous, the solution became slightly acid by reason of the creation of lactic acid. When the souring process had continued sufficiently, the nutrient solution or wort thus attained was drained off and put with the seed yeast into the fermenting tank where the actual propagation of yeast from the seed yeast took place. In later years, particularly during the course of the World War which required conservation of grains, molasses was used as the source of sugar in the making of nutrient solutions in lieu of cereals. In 1919 inorganic salts capable of nourishing yeast were used in place of organic nitrogenous materials. This forward step in the art properly may be described as revolutionary. Judge Soper in Fleischmann Yeast Co. v. Federal Yeast Corporation so described it. With comparatively immaterial changes this method of producing nutrient solutions is substantially that used today.

We should state that the patent under discussion does not claim the method of producing nutrient solutions by the use of molasses and yeast nourishing inorganic materials. There is no patentable novelty in making use of such materials for the creation of nutrient solutions. Hayduck does not make such a claim.

The prior art makes plain that nutrient solutions must be slightly acid in order to stimulate the growth of the yeast and to prevent the formation of harmful bacteria or fungi. Nutrient solutions must not be too acid, however. The "new" process (called such to distinguish it from that which was very old in the art) of using inorganic yeast nourishing materials, such as ammonium sulphate, heightens the problem of acidity. If ammonium sulphate is used with molasses in a nutrient solution, as the yeast eats into it sulphuric acid is released and causes harmful acidity in the nutrient solution itself. Neither the problem of acidity nor its solution, as we will show hereafter, was new to the art. Nor did acidity result only when inorganic yeast nourishing salts were employed in the nutrient solution. As we have stated, when organic materials such as cereals were soured

in the souring tank lactic acid was formed. An examination of the record, however, convinces us that the problem of excessive acidity caused comparatively little concern to manufacturers of yeast prior to the use of inorganic yeast nourishing salts which increased that acidity.

In the specification of the patent under consideration Hayduck states, "I have now discovered that unexpectedly high yeast yields are obtained when conducting the nutrition of the yeast with the use of solutions containing sugar and yeast-nutrient inorganic salts . . . if the acid components referred to as being set free during the yeast propagation and growth are neutralized either entirely or to such an extent that they no longer affect the yeast unfavorably. For such neutralization of the acid components, calcium carbonate may suitably be employed, but other basic or antacid substances such as antacid substances containing or supplying nitrogen can also be employed for the neutralization, for example ammonium carbonate."

As to the knowledge of the prior art in respect to neutralizing deleterious acidity, Hayduck states in his specifications, "It is known that there can be added to mashes in lactic fermentation, nitrogen-supplying antacid substances, as for instance ammonia, ammonium carbonate or ammonium carbamate, for the partial neutralization of the lactic acid progressively formed and for the augmentation of the yeast-assimilable nitrogen content of the mashes so that they may be utilized for subsequent yeast propagation.

"It is also known that an addition of basic or antacid substances to some fermenting liquids stimulates the fermentation, the injurious action of the acids on the life of the yeast being inhibited. Furthermore, there has already been some theoretical discussion with respect to the possibility of obtaining yeast on an industrial scale from solutions containing sugar and inorganic salts."

The references made by Hayduck to the prior art and the claimed differentiation over the prior art as thus summarized in his specifications would not appear to constitute

invention in the light of the prior art. To repeat Hayduck's words, "It is also known that an addition of basic or antacid substances to some fermenting liquids stimulates the fermentation, the injurious action of the acids on the life of the yeast being inhibited." This is a recognition of the injurious nature of the acid created by feeding yeast and of the corrective action of an antacid substance. The claimed differentiation and the substance of Hayduck's invention is alleged to be in the unexpectedly large yield of yeast obtained by the use of the process disclosed, but this in the absence of other factors upon which a discovery by Hayduck can be predicated would not appear to amount to invention.

We think that the test of invention to be applied to the patent *sub judice* may be summed up as follows: patentable invention under the circumstances of the case at bar must consist of two elements; first, the inventor must discover the working of a natural law; second, he must put that natural law to effective use. In the case at bar Hayduck cannot claim and does not claim to be the discoverer of the fact that the growth of yeast may be stimulated by neutralizing the acid by an antacid. The operation of this natural law in respect to yeast was discovered by others before him and, as we will show, is a well established part of the prior art. Hayduck's claim is not that he has discovered the operation of the law but that he has put that natural law to use with unexpectedly good results. Both elements, however, must be present to constitute patentable invention. Hayduck, however, can claim and does claim only one, viz., the last.

Hayduck alleges invention in the unexpected production of an unusually large yield of yeast under his process, but he makes no disclosure as the discoverer of any natural law or of circumstances accounting for this exceptionally large yield. If h. had done so, then he would have made an invention valid over the prior art. For example, if Hayduck had gone to Henneberg's experiments or the experiments of others in the art and had discovered that cer-

tain experiments had produced greater yields of yeast than others because of the operation of factors not perceived by Henneberg or prior workers such would have constituted invention. As a matter of fact the large yield of yeast is due to the use of an antacid, a reason recognized by Hayduck in his specification and by the prior art.

In respect to the prior art, it appears from the record before us and we think that it is apparent upon consideration of the opinion of the District Court for the District of Maryland in Fleischmann Yeast Co. v. Federal Yeast Corp., supra, that in all probability, W. Henneberg, the chemist to whom we have referred in the preceding paragraph, was among the first discoverers of the natural law which forms the basis of Hayduck's claimed invention. In an article published by Henneberg in Germany in 1908, entitled, "Brewing, Wines, Spirits, Etc. Yeast: Influence of meal and other nitrogenous materials, salts and acids on the life and fermenting power of . . . in distilled water with sucrose and in worts", he states, "The author has carried out an extensive series of experiments which show that rye or wheat-meal, egg albumin peptone, lecithin and inorganic ammonium salts exhibit striking similarities in their action on yeasts." Henneberg then goes on to state the circumstances under which these substances are of nutritive value or are poisonous or non-poisonous in relation to yeast. He then states, "The inorganic ammonium salts have an approximately equal poisonous action on both kinds of yeast.[1] Under ordinary conditions, these nitrogenous substances form excellent nutrient materials for yeasts, their injurious action only appearing in the absence of certain salts, which are more especially compounds capable of neutralizing acids. The other salts able to annul this injurious action of the nitrogenous substances comprise all the calcium salts with the exception of the oxalate and, in much greater concentrations, magnesium sulphate, ammonium sulphate, po-

[1] Henneberg was referring to brewing and distilling yeasts.

tassium phosphate, etc.; the experiments show that calcium and certain other salts are capable of acting to some extent, on acids in such a way as to render them less harmful to the yeast. It must, therefore, be assumed that the nitrogenous compounds give rise, in the interior of the cells, to free acids, which, under normal conditions, are immediately rendered innocuous by the above-mentioned salts; if such salts are lacking, the acids exert a poisonous action on the cells. In the case of ammonium salts, these must undergo decomposition in order to take part in the formation of proteins, the acid of the ammonium salt being liberated; if, therefore, this acid has a poisonous action on yeast, the corresponding ammonium salt will have a similar action." See also an article similar in tenor derived from Henneberg published in the magazine "Pure Products" for May, 1908, in New York City. This article recognizes the phenomenon of the generation of free acid when yeast is used in brewing and distilling processes and the fact that such acids may be rendered innocuous by the addition of lime salts.

In his specification in the patent *sub judice* Hayduck states, "An outstanding novel and technically important feature of my present invention as compared with the process described and claimed in my aforesaid copending application Serial No. 420,829 [2] resides in the fact that by means

[2] In the patent specification Hayduck in respect to his copending application states:

> "In the production of yeast in accordance with the process described in German Patent No. 300,663, and in my corresponding copending application for United States Patent Serial No. 420,829, filed October 30, 1920, there takes place in solutions of sugar and inorganic salts, even when no bacterial infection sets in, a considerable increase in the acid content of the nutrient solution in which the yeast is produced. The resultant acidity is, for the most part, of an inorganic nature, and such inorganic acid is released from the inorganic salts used, the basic parts are used to a large extent as nutriment by the yeast, while the residual acid parts remain.

of the careful neutralization of the aforesaid acid components set free are neutralized either entirely or to an extent that they no longer affect the yeast unfavorably whereby yeast yields may be obtained which have not been obtainable hitherto by any process and which could not have been predicted from the known facts."

If we compare these words of Hayduck's specification with Henneberg's article, we think it is apparent that Hayduck was aware of Henneberg's work and therefore Hayduck did not himself discover the operation of the natural law which Henneberg referred to. While it is true that Henneberg was dealing with yeast in brewing and distilling processes and not with the manufacture of yeast in our opinion invention cannot rest upon such a ground of distinction in the closely allied fields of brewing, distilling and yeast making. It must also be borne in mind, as appears from the opinion in Fleischmann Yeast Co. v. Federal Yeast Corp., supra, at p. 192, that Hayduck was a coworker with Henneburg in the Technical-Scientific laboratory of the Institute for Fermentation Industries in Berlin, and that Henneberg conducted laboratory experiments to discover why certain nitrogenous substances killed yeast while Hayduck conducted large scale experiments in breweries to the same end.

Knowledge of the deleterious effect of acidity upon yeast was known to the art prior even to Henneberg. In an article by A. Wilfert (Presshefe, Kunsthefe Und Backpulver) published in Vienna in 1890, reference is made to

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This selective partial utilization by the yeast of components of inorganic salts present tends to result in an accumulation of acid products or free inorganic acids and tends increasingly to acidify the solution in which the yeast is being propagated or grown. Because of the presence of these free acids, the yeast, as can be seen by examination of the same with a microscope, is influenced unfavorably if the acids exert their action unrestrainedly upon the yeast for any considerable length of time."

the disadvantageous action of sulphuric acid on yeast when it is present in large amounts and the article states that if it is desired to remove the acid from the mash it may be done simply by adding slaked lime to the neutralizer. Slaked lime is calcium hydroxide and is an antacid. Wilfert states, "The sulphuric acid acts disadvantageously on the development of the yeast only when it is present in large amounts; conversely, a small amount of sulphuric acid is highly beneficial for the development of the yeast, as it contributes considerably to the production of a very pure and vigorous yeast. The yeast plant requires for its vigorous growth a liquid which is slightly acid; apart from the fact that this constitution of the liquid promotes the development of the yeast plant, it renders the development of fission fungi almost entirely impossible, inasmuch as the latter, as experience has shown, can thrive well in neutral and alkaline liquids but cannot develop in acid liquids."

In Pollak's Swiss Patent of 1913, entitled "Process of Acidifying Fermenting Substrates by the Use of Ammonium Compounds", reference is made to the creation of a natural acidification in the mash in a plurality of the processes used in the fermenting industry to increase the fitness of the liquid. Pollak also states that if it is desired to push the formation of acid further and also to impart greater intensity to the physiological processes taking place at the same time, ". . . the already existing acid concentration which interferes with the fermentation, must be reduced by neutralizing by means of an alkali." He then states as the gist of his invention that it is new to use ". . . ammonia compounds, e. g., ammonia or strongly alkaline ammonium compounds for instance, in a manner such that they are repeatedly added to the fermenting substrates with the object of repeated partial neutralization of the acid resulting from the fermentation." It is true as is pointed out by the learned District Judge in Fleischmann Yeast Co. v. Federal Yeast Corp., supra, p. 191, that Pollak's process is to be employed with the end result of increasing the acid,

increasing the yield of the yeast thereby, but the fact remains that Pollak did disclose a method of control of acidity by neutralizing acids by means of the "ammonia compounds, e. g., ammonia or strongly alkaline ammonium compounds."

The Hayduck patent describes a suitable yeast nutrient solution containing sugar, ammonium sulphate, ammonium dihydrogenphosphate, potassium sulphate, gypsum and magnesium sulphate, but Hayduck does not claim that the successful working of his process depends upon exact measurement of the amount of chemicals used to the end that harmful acidity may be reduced or done away with. In other words, he claims no formula depending for its effect on precise and exact neutralization and, moreover, he states, ". . . for neutralization of the acid components calcium carbonate may suitably be employed, but other basic or antacid substances such as antacid substances containing or supplying nitrogen can also be employed for the neutralization, for example ammonium carbonate."

The first claim of Hayduck's patent is typical. It claims, "The process of manufacturing yeast which comprises preparing a yeast nutrient solution and propagating yeast therein with aeration,[3] said yeast nutrient solution containing essentially sugar material and yeast nourishing inorganic salts from which components are liberated which tend increasingly to acidify the nutrient solution during propagation, and during the period of propagation neutralizing the deleterious excess of such acidity."

It should be noted that every claim in the patent is a process claim. Some of them refer to a process of neutralizing the excessive acidity ". . . by the addition of an innocuous antacid substance." One refers to neutralizing by an innocuous carbonate and one by ammonium carbonate. The use of calcium carbonate as the antacid substance is referred to in the specification.

[3] A process well known to the art consisting of stimulating the growth of the yeast by putting air into or through the nutrient solution.

As we have stated, there is nothing new, nor is it claimed that there is anything new or patentable in the use of sugar or in the use of molasses with inorganic salts, such as ammonium sulphate to create nutrient solutions for the manufacture of yeast. The element of invention claimed by Hayduck consists in the production of unusually large yields of yeast by the use of a neutralizer for the acid components during the period of the propagation of the yeast.

To sum up the situation in respect to the prior art, we think that it cannot be denied that the use of antacid or basic materials as neutralizers for acidity in respect to yeast is old in the art. At times the application of antacid materials has been made when acidity has been induced in the fermenting vat; at times, when it has arisen there undesired. The repulsion of acidity in distilling and brewing with yeast was early made known to the art by Henneberg and others. At the most, in the patent *sub judice* Hayduck has applied the prior art to the propagation of yeast when acidity was deleterious and unwanted. At the least, he has not done as much as this since Wilfert disclosed the principle upon which Hayduck rests his disclosure in respect to the propagation of yeast. We think that Hayduck has simply set forth a technique which is useful in the manufacture of yeast under modern methods. Hayduck's disclosures do not attain to the dignity of invention. His process is the result of the exercise of the skill of the calling, the application of an old principle to a similar or analogous subject with no change in the manner of application and without any substantially different result.

For these reasons we hold Hayduck -103 to be invalid for want of invention over the prior art. Altoona Theatres v. American Tri-Ergon, 294 U. S. 477, 486; Paramount Publix v. American Tri-Ergon, 294 U. S. 464, 473; DeForest Radio Co. v. General Electric Co., 283 U. S. 664; United States Hoffmann Corp. v. Pantex, 44 F. (2nd) 685, 688.

As to Hayduck Patent No. 1,449,105.

This patent is described as a "Low-Alcohol Yeast Process" and describes a process for the manufacture of yeast in such a way that the production of alcohol in the fermentative process is kept at a minimum. Claim 4 of the patent is typical. It is for "A process of propagating yeast with a relatively low yield of alcohol which comprises preparing a wort containing all essential yeast nutrients in solution, initiating propagation of yeast in a diluted portion of said wort, aerating the diluted portion, and substantially continuously adding during the period of propagation, a wort of higher concentration, at a rate such that the yeast may propagate and substantially all of the alcohol which may be formed is assimilated by the yeast." As the fermentative process takes place alcohol is generated in the nutrient solution by the feeding yeast. The patent contemplates the management of the process in such a wise that the nutrient solution will be kept at such a relatively low concentration that the amount of alcohol produced will never go beyond that which the feeding yeast can absorb.

In the patent specification Hayduck describes his process as follows. A wort suitable for yeast propagation is prepared, having a gravity of 12° Balling. A portion of this wort is placed in the fermenting vat and is diluted for example to about 1° Balling. Seed yeast is thereupon added to the solution, aeration takes place and the process of manufacturing yeast begins. The remainder of the concentrated wort is added ". . . slowly and substantially continuously throughout a protracted period of time and at a rate such that not only the alcohol which may have been formed from the quantity of sugar present in the diluted portion of the wort, but also any alcohol which may be formed from the sugar which is present in the added wort, can be assimilated immediately by the yeast." The gist of the patent therefore is for a rate of feeding the wort into the nutrient solution already in the fermenting vat.

We think there is no doubt but that Hayduck clearly recognized that it was old in the art to dilute the wort to such an extent that the alcohol produced from the sugar could be assimilated again by the feeding yeast as part of its nourishment. Hayduck refers to Rainier's German patent, No. 10,135, stating in effect that the German patent endeavors to reach the same goal as himself by adding to the nutrient solution peptones continuously and sugar at intervals and teaches that by keeping the sugar concentration low the formation of alcohol is prevented, the sugar serving of course as a nutrient. Hayduck states, however, that the operation of the process described by Rainier requires the estimation of the sugar and peptone content prior to further additions of the respective solutions containing these nutrients and it therefore lacks the simple operation characterizing his process which permits the use of concentrated wort.

We are convinced, however, that there is little difference in substance between beginning fermentation with a wort at 1° Balling and adding nutrient solution at 12° Balling from time to time to prevent the excess production of alcohol as taught by Hayduck and beginning the fermentative processes with such a low concentration of sugar in the nutrient solution that the feeding yeast will not produce excessive alcohol as taught by Rainier, particularly when it is borne in mind that the extent of permissible concentration of the nutrient solution in relation to the production of alcohol must be ascertained by tests made as the yeast manufacturing process progresses. No other method of ascertaining the rate at which the concentrated nutrient solution is to be added is disclosed by Hayduck. Both Hayduck and Rainier endeavor to control the production of alcohold by the feeding yeast simply by restricting the extent of the field in which alcohol can be formed.

It was well known to the prior art that if the creation f alcohol was not desired the nutrient solution should contain a low concentration of sugar. Iwanowski, in his arti-

cle published in 1903 in the Journal of the Society of Chemical Industry, points out that ". . . the higher the concentration of sugar in the nutrient solution, the stronger is the alcoholic fermentation; . . . in solutions which contain about 0.5 per cent of sugar and about double that quantity of peptone, hardly any alcoholic fermentation is to be observed."

In our opinion the process described by Hayduck may constitute a mechanical improvement over the prior art but it is no more than this. But even if the process disclosed by Hayduck be held to constitute invention, the patent is invalid for indefiniteness as was held by the learned District Judge. Both the times and manner in which the concentrated nutrient solution is to be added may be ascertained as we have stated solely by experimentation. The disclosure of the patent is therefore too vague and indefinite to constitute invention.

In our opinion the validity of the disclosure of the patent is not aided by providing as does Hayduck that the quantity of diluted wort originally placed in the fermenting tank is so chosen that the mean content of the entire wort employed would be 3° to 5° Balling. This instruction neither adds to the ease with which the calculation of the Balling content of the nutrient solution in the fermentation tank can be ascertained nor does it add anything original to the processes of the prior art. It is settled that if the disclosure of a patent is so indefinite as to require independent experiments, the patent is void. Chemical Rubber Co. v. Raymond Rubber Co., 71 F. 179; George K. Hale Mfg. Co. v. Hafleigh & Co., 52 F. (2d) 714; Health Products Corp. v. Ex-Lax Mfg. Co., Inc., 22 F. (2d) 286.

As to Hayduck Patent No. 1,449,106.

It is stipulated by the parties that this patent combines the processes of Hayduck -103, including the principle of neutralization, and the processes of Hayduck -105, including the regulated rate of feeding the nutrient solu-

tion. Since we have found patents Hayduck -103 and Hayduck -105 to be invalid it follows that we find this patent to be invalid since combining the processes of invalid process patents cannot result in validity.

As to Hayduck Patent No. 1,449,109.

The learned District Judge held ". . . this patent covers the same field as those hereinbefore considered. Its disclosure of the use of a nitrogenous neutralizing agent adds nothing to the art since Hayduck No. 1,449,103 makes that disclosure. It is therefore invalid." It is very difficult to distinguish any substantial difference between the disclosures of this patent, -106 and -103. It is claimed by its proponent that the process of the patent combines the process of Hayduck's -105, namely regulated nutrient feed but with an additional factor of supplying to the nutrient solution a chemical substance possessing assimilable nitrogen and also having an alkaline or antacid reaction, such chemical to be fed to the fermenting tank along with the reserve nutrient solution as the latter is needed.

We have already stated our reasons for holding the neutralization patent, Hayduck -103, and the regulated rate of feeding patent, Hayduck -105, to be invalid. The two processes referred to are old for the reasons we have heretofore stated, but in his specification in -109 Hayduck refers to the use of ammonium sulphate to be ". . . set on with the seed yeast." He states: "The remainder of the nitrogenous substance required for supplying necessary yeast assimilable nitrogen for the yeast, is added in the form of free ammonia (ammonia water), to the relatively concentrated nutrient solution . . . ." But there is nothing new in the use of ammonium salts in a nutrient solution. Mohlant's British Patent No. 11,617 refers to the use of ammonium phosphate in fermentation and distillation processes. Fritche's Austrian Patent, 45/4047 refers to ammonium salts, particularly ammonium sulphate, to ". . . serve as nutrients for the yeast cells." Pollak's Swiss

patent, heretofore mentioned, refers to the use of ammonium carbonate or carbamate. The ammonium salts referred to in Hayduck -109 are thus shown to be old in use for the very purposes for which Hayduck's process makes use of them.

Since the component parts of the process set out by the patent are old it follows that a combination of these processes contains no novelty and the patent is void for want of invention.

As to Corby and Bührig Patent No. 1,673,375.

The disclosures of this patent are in substance analogous to those of Hayduck -105 and Hayduck -106, with the exception that the patent teaches that a portion of the nutrient solution may be withdrawn periodically from the fermenting tank, the residue diluted, new nutrient solution added with a continuation of the process of propagation of the yeast in the fermenting tank.

The learned District Judge aptly likened the disclosure of this patent to the action of a farmer harvesting a portion of an agricultural crop and re-seeding the area from which it came. The proponent of the patent asserts that the analogy is unsound, that what the patentees did was in fact to harvest a portion of the crop, then restore the starting conditions of the solution and then grow another crop *without re-seeding*. If such was in fact the case it is our opinion that the process disclosed would not only be patentable but would constitute a phenomenon unknown to nature. An examination of the process discloses, however, that the yeast remaining in the nutrient solution fructifies itself in the fresh nutrient solution which is added after the old is withdrawn. There is no element of patentable novelty in the conception disclosed in the patent.

The decree of the District Court of November 30, 1937, is reversed in so far as the same adjudicates claims 1 to 4, inclusive, and 7 to 15, inclusive, of Hayduck -103 to be valid, grants an injunction and directs recovery by Stand-

ard Brands, Incorporated, by way of accounting against National Grain Yeast Corporation, and the cause is remanded with directions to dismiss the bill of complaint *in toto*. The decree of the District Court is in all other respects affirmed.

A true Copy:
Teste:

Clerk of the United States Circuit Court of Appeals for the Third Circuit.

ORDER AFFIRMING DECREE WITH EXCEPTIONS.

(Filed February 1, 1939.)

IN THE UNITED STATES CIRCUIT COURT OF APPEALS,
FOR THE THIRD CIRCUIT.

No. 6651. March Term, 1938.

Standard Brands, Incorporated,
Plaintiff-Appellant,

v.

National Grain Yeast Corporation,
Defendant-Appellee.

APPEAL FROM THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF NEW JERSEY.

This cause came on to be heard on the transcript of record from the District Court of the United States, for the District of New Jersey, and was argued by counsel.

On consideration whereof, it is now here ordered, adjudged, and decreed by this Court that the decree of the said District Court in this cause be, and the same is hereby affirmed, with costs, except in so far as it refers to claims 1 to 4 inclusive and 7 to 15 inclusive of Hayduck Patent No. 1,449,103.

Philadelphia,
February 1, 1939.

JOHN BIGGS, JR.,
Circuit Judge.

ORDER REVERSING DECREE, ETC.

(Filed February 1, 1939.)

IN THE UNITED STATES CIRCUIT COURT OF APPEALS,
FOR THE THIRD CIRCUIT.

No. 6670. March Term, 1938.

National Grain Yeast Corporation,
Defendant-Appellant,

v.

Standard Brands, Incorporated,
Plaintiff-Appellee.

APPEAL FROM THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF NEW JERSEY.

This cause came on to be heard on the transcript of record from the District Court of the United States, for the District of New Jersey, and was argued by counsel.

On consideration whereof, it is now here ordered, adjudged, and decreed by this Court that the decree of the said District Court in this cause be, and the same is hereby reversed, with costs, in so far as it adjudicates claims 1 to 4 inclusive and 7 to 15 inclusive, of Hayduck Patent No. 1,449,103 valid and infringed, but in all other respects affirmed, with direction to the said District Court to dismiss plaintiff's bill of complaint in toto.

Philadelphia,
February 1, 1939.

JOHN BIGGS, JR.,
Circuit Judge.

CLERK'S CERTIFICATE.

UNITED STATES OF AMERICA,
EASTERN DISTRICT OF PENNSYLVANIA, } *Sct.:*
THIRD JUDICIAL CIRCUIT.

I, Wm. P. Rowland, Clerk of the United States Circuit Court of Appeals for the Third Circuit, Do HEREBY CERTIFY the foregoing to be a true and faithful copy of the original Transcript of Record, Volume I, and proceedings in this court in the cases of Standard Brands, Inc., Plaintiff-Appellant, v. National Grain Yeast Corp., Defendant-Appellee, No. 6651; National Grain Yeast Corp., Defendant-Appellant, v. Standard Brands, Inc., Plaintiff-Appellee, No. 6670, on file, and now remaining among the records of the said court, in my office.

IN TESTIMONY WHEREOF, I have hereunto subscribed my name and affixed the seal of the said Court, at Philadelphia, this twentieth day of February, in the year of our Lord one thousand nine hundred and thirty-nine and of the Independence of the United States the one hundred and sixty-third.

(Seal)

WM. P. ROWLAND,
Clerk of the U. S. Circuit Court of Appeals, Third Circuit.

Vol. II

TRANSCRIPT OF RECORD

Supreme Court of the United States

OCTOBER TERM, 1939

No. 9

STANDARD BRANDS, INCORPORATED,
PETITIONER,

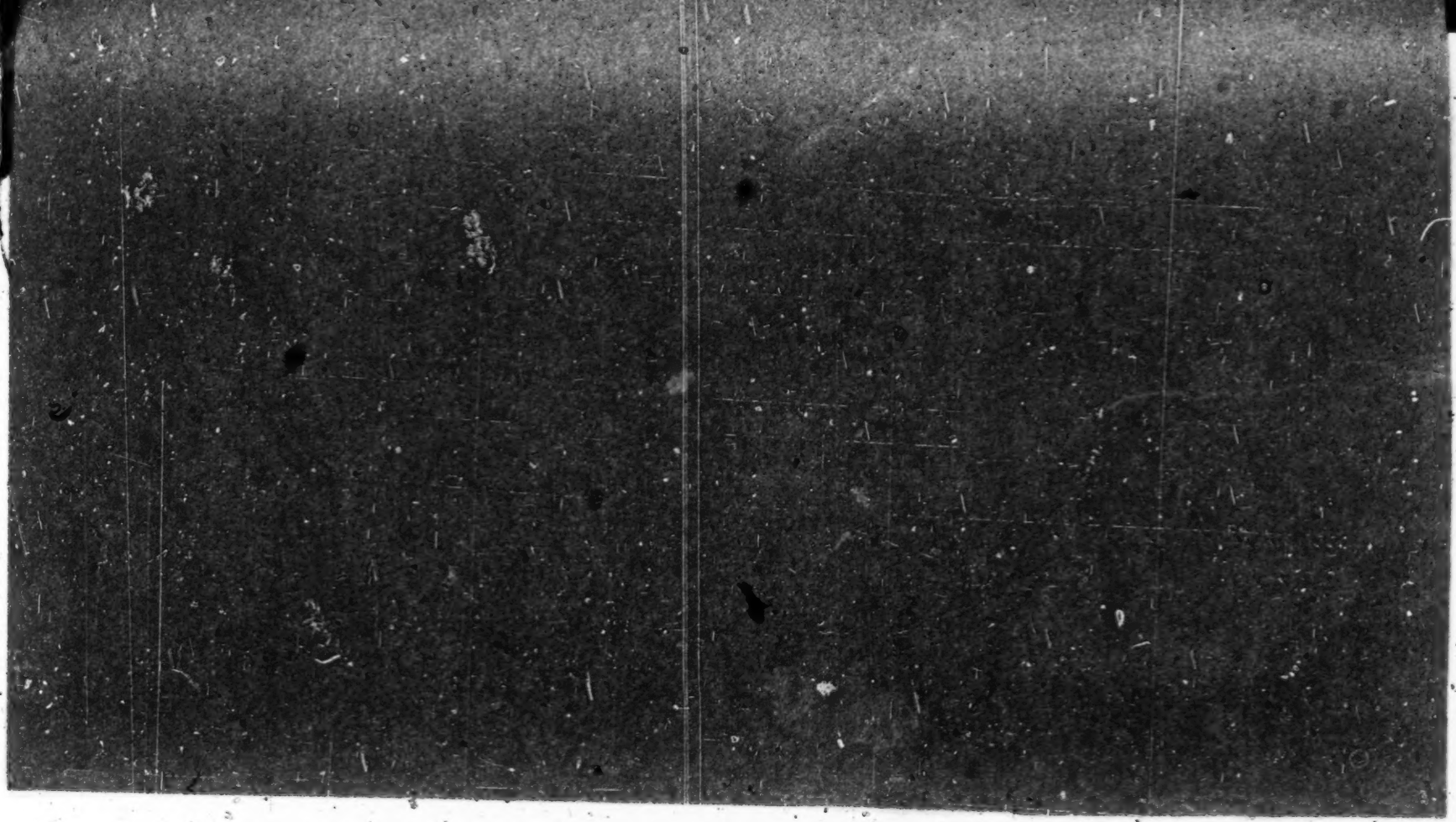
vs.

NATIONAL GRAIN YEAST CORPORATION

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APEALS FOR THE THIRD CIRCUIT

PETITION FOR CERTIORARI FILED FEBRUARY 25, 1939.

CERTIORARI GRANTED MARCH 27, 1939.



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PLAINTIFF'S EXHIBITS

PLAINTIFF'S EXHIBIT P-1.

Patented Mar. 20, 1923. 1,449,103

UNITED STATES PATENT OFFICE.

FRIEDRICH HAYDUCK, OF WILMERSDORF, GERMANY, ASSIGNOR TO THE FLEISCHMANN COMPANY, OF NEW YORK, N. Y., A CORPORATION OF OHIO.

PROCESS FOR THE MANUFACTURE OF COMPRESSED YEAST.

No Drawing. Application filed October 30, 1920. Serial No. 420,830.

(GRANTED UNDER THE PROVISIONS OF THE ACT OF MARCH 3, 1921, 41 STAT. L., 1313.)

To all whom it may concern:

Be it known that I, FRIEDRICH HAYDUCK, a citizen of Germany, residing at Wilmersdorf, Germany, have invented certain new and useful Improvements in Processes for the Manufacture of Compressed Yeast and the Product (for which application for patent was filed as follows, Germany, March 15, 1915, Patent No. 303,251), of which the following is a specification.

This invention relates to a process for the manufacture of yeast, particularly bakers' yeast, by propagation in a solution containing sugar material and yeast nourishing inorganic salts.

An object of this invention is to provide a procedure for the manufacture of yeast on a large scale commercially, there being added to the nutrient solution which contains sugar material and yeast nourishing inorganic salts a neutralizing agent for neutralizing the deleterious excess of acidity.

Another object is to provide a good bakers' yeast in a convenient and economical manner.

In the production of yeast in accordance with the process described in German Patent No. 300,663, and in my corresponding co-pending application for United States Patent Serial No. 420,829, filed October 30, 1920, there takes place in solutions of sugar and inorganic salts, even when no bacterial infection sets in, a considerable increase in the acid content of the nutrient solution in which the yeast is produced. The resultant acidity is, for the most part, of an inorganic nature, and such inorganic acid is released from the inorganic salts used, the basic parts are used to a large extent as nutriment by the yeast, while the residual acid parts remain. This selective partial utilization by the yeast of components of inorganic salts present tends to result in an accumulation of acid products or free inorganic acids and tends increasingly to acidify the solution in which the yeast is being propagated or grown. Because of the presence of these free acids, the yeast, as can be seen by examination of the same with a microscope, is influenced unfavorably if the acids exert their action unrestrainedly upon the yeast for any considerable length of time.

I have now discovered that unexpectedly high yeast yields are obtained when conducting the nutrition of the yeast with the use of solutions containing sugar and yeast-nutrient inorganic salts in accordance with a process of the character exemplified in my aforementioned copending application Serial Number 420,829, if the acid components referred to as being set free during the yeast propagation and growth are neutralized either entirely or to such an extent that they no longer affect the yeast unfavorably. For such neutralization of the acid components, calcium carbonate may suitably be employed, but other basic or antacid substances such as antacid substances containing or supplying nitrogen can also be employed for the neutralization, for example ammonium carbonate.

A suitable yeast-nutrient solution for the propagation of yeast according to the method of my present invention may be formed as follows and as described in my aforesaid co-pending application Serial No. 420,829: 100 parts of sugar are dissolved in tap water together with 6 parts ammonium sulfate, 2 parts ammonium dihydrogenphosphate ($NH_4H_2PO_4$), 4 parts potassium sulfate, 2½ parts of gypsum and 2½ parts magnesium sulfate and the solution is made up to a total quantity of 6500 to 7000 parts with the requisite quantity of water, (all "parts" being stated by weight).

The process of my present invention may be executed in such manner, for example that calcium carbonate is added to the nutrient solution either at the beginning or fractionally during the process, to an amount corresponding to the sulfuric acid contained in and which may be set free from the ammonium sulfate used in the yeast growing process in case ammonium sulfate is employed as one of the principal inorganic yeast-nutrient salts. In the case of such employment of ammonium sulfate, in accordance with the molecular weight of the compounds involved, there may be suitably employed for every 10 parts by weight of ammonium sulfate (since the yeast tends to utilize for its nutrition the total basic part of this salt) up to 7½ parts by weight of calcium carbonate. Molasses may be used in my process as a suitable source of sugar for the yeast production and if molasses

naturally containing antacid substances is used as the sugar-containing raw material the quantity of calcium carbonate employed can be reduced materially, as the antacid substances present in such molasses neutralize a part of the free acid. Whether calcium carbonate or an antacid nitrogen-supplying substance or other neutralizing agent be used it will, of course, be employed in such amount as to neutralize whatever detrimental excess of free acid tends to develop in the nutrient medium during the yeast growth and as stated above it may be added fractionally in successive portions.

The technical advantages of my improved process hereinafter claimed can be seen from the following:

While in a process as described in my above-mentioned copending application for United States Patent No. 420,829, from 100 kilograms of sugar employed in the yeast-nutrient solution not more than about from 70 to 80 kilograms of compressed bakers' yeast is ordinarily obtained, there can be obtained when making use of the method including neutralization in accordance with the process of this present application, up to 160 kilograms of bakers' yeast from a nutrient solution containing 100 kilograms of sugar, and, if there is used a quick growing species of yeast, up to 300 kilograms of compressed yeast can be obtained from such a nutrient solution containing 100 kilograms of sugar, that is, therefore, from two to four times the yield obtained in the heretofore usual process employing cereal wort for the manufacture of yeast by the aeration method, calculated on the starch or available carbohydrate content of the raw materials, and up to approximately twice the yield, similarly calculated, obtained by my improved process as set forth in my copending application for United States patent Serial Number 420,829.

The neutralization of acids may also be advantageous in processes involving the fermentation of pure sugar solutions in the presence of inorganic salts in certain instances even when the obtainment of yeast is not intended.

It is known that there can be added to mashes in lactic fermentation, nitrogen-supplying antacid substances, as for instance ammonia, ammonium carbonate or ammonium carbamate, for the partial neutralization of the lactic acid progressively formed and for the augmentation of the yeast-assimilable nitrogen content of the mashes so that they may be utilized for subsequent yeast propagation.

It is also known that an addition of basic or antacid substances to some fermenting liquids stimulates the fermentation, the injurious action of the acids on the life of the yeast being inhibited. Furthermore, there has already been some theoretical discussion with respect to the possibility of obtaining yeast on an industrial scale from solutions containing sugar and inorganic salts. A practical embodiment of such a process, based upon my discoveries, is described in and broadly claimed in my copending application for United States patent Ser. No. 420,829 hereinabove referred to. An outstanding novel and technically important feature of my present invention as compared with the process described and claimed in my aforesaid copending application Serial No. 420,829 resides in the fact that by means of the careful neutralization of the aforesaid acid components set free are neutralized either entirely or to an extent that they no longer affect the yeast unfavorably whereby yeast yields may be obtained which have not been obtainable hitherto by any process and which could not have been predicted from the known facts.

While in the foregoing description I have given a detailed embodiment of my present invention, it will, of course, be apparent that the invention is not limited to the use of the particular substances employed as yeast nutrients but that my present invention is merely typified and illustrated by the example given and includes broadly all such processes as come within the scope of the claims hereinafter presented, bearing in mind the fact that substances such as fermentable sugars, added as such or in the form of molasses, and suitable yeast-nutrient salts as typified by those in the example given will be used, in accordance with my process and claims, in such aggregate quantities and in such proportions as are requisite for supplying in the proper proportions and in yeast-assimilable form or combination the necessary carbon, nitrogen, phosphorus and other essential yeast-constituent elements for the production of yeast in such quantities as are desired and preferably in the high yield hereinabove indicated as obtainable by the process of my present invention, when carried out with suitable aeration of the nutrient solution during the yeast production. It is known that the fermenting power and other desirable characteristics of yeast are to a certain degree dependent upon a sufficiency, in the nutrient solution in which the yeast is produced, of nitrogen-supplying substances and in the practice of my present invention such a quantity of ammonium salts and other substances will of course be ordinarily employed as will produce a compressed yeast having the well-known desirable nitrogen content and properties.

As is stated in my German Patent No. 300,663 and in my corresponding application for United States patent Serial No. 420,829, specially good results with respect

to the obtainment of high yields of yeast from nutrients of the types involved in the present application may be secured by employment of nutrient solutions which have a density of not more than 2° on the saccharometer.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. The process of manufacturing yeast which comprises preparing a yeast nutrient solution and propagating yeast therein with aeration, said yeast nutrient solution containing essentially sugar material and yeast nourishing inorganic salts from which components are liberated which tend increasingly to acidify the nutrient solution during propagation, and during the period of propagation neutralizing the deleterious excess of such acidity.

2. The process of manufacturing yeast which comprises preparing a yeast nutrient solution and propagating yeast therein with aeration, said yeast nurtient solution containing essentially sugar material and yeast nourishing inorganic salts from which components are liberated which tend increasingly to acidify the nutrient solution during propagation, and during the period of propagation neutralizing the deleterious excess of such acidity by the addition of an innocuous antacid substance.

3. The process of manufacturing yeast which comprises preparing a yeast nutrient solution and propagating yeast therein with aeration, said yeast nutrient solution containing essentially sugar material and yeast nourishing inorganic salts from which components are liberated which tend increasingly to acidify the nutrient solution during propagation, and during the period of propagation neutralizing the deleterious excess of such acidity by the fractional addition of an innocuous antacid substance.

4. The process of manufacturing yeast comprises preparing a yeast nutrient solution and propagating yeast therein with aeration, said yeast nutrient solution containing essentially sugar material and yeast nourishing inorganic salts from which components are liberated which tend increasingly to acidify the nutrient solution during propagation, and during the period of propagation neutralizing the deleterious excess of such acidity by the addition of an innocuous antacid substance adapted to supply yeast assimilable nitrogen to the yeast.

5. The process of manufacturing yeast which comprises preparing a yeast nutrient solution and propagating yeast therein with aeration, said yeast nutrient solution containing essentially sugar material and yeast nourishing inorganic salts from which components are liberated which tend increasingly to acidify the nutrient solution during propagation, and during the period of propagation neutralizing the deleterious excess of such acidity by the addition of an innocuous carbonate.

6. The process of manufacturing yeast which comprises preparing a yeast nutrient solution and propagating yeast therein with aeration, said yeast nutrient solution containing essentially sugar material and yeast nourishing inorganic salts from which components are liberated which tend increasingly to acidify the nutrient solution during propagation, and during the period of propagation neutralizing the deleterious excess of such acidity by the addition of ammonium carbonate.

7. The process of manufacturing yeast which comprises preparing a yeast nutrient solution and propagating yeast therein with aeration, said yeast nutrient solution containing essentially sugar material and yeast nourishing inorganic salts including a compound containing yeast assimilable nitrogen which is adapted to be at least partially assimilated by the yeast and from which during such assimilation components are liberated which tend increasingly to acidify the nutrient solution during propagation, and during the period of propagation neutralizing the deleterious excess of such acidity.

8. The process of manufacturing yeast which comprises preparing a yeast nutrient solution and propagating yeast therein with aeration, said yeast nutrient solution containing essentially sugar material and yeast nourishing inorganic salts including an inorganic ammoniacal compound adapted to supply at least a material portion of yeast assimilable nitrogen required by the yeast during propagation, said salts being of a character such that components are liberated which tend increasingly to acidify the nutrient solution during propagation, and during the period of propagation neutralizing the deleterious excess of such acidity.

9. The process of manufacturing yeast which comprises preparing a yeast nutrient solution and propagating yeast therein with aeration, said yeast nutrient solution containing essentially sugar material and yeast nourishing inorganic salts including ammonium sulphate which is adapted to be at least partially assimilated by the yeast and from which during such assimilation components are liberated which tend increasingly to acidify the nutrient solution during propagation, and during the period of propagation neutralizing the deleterious excess of acidity.

10. The process of manufacturing bakers' yeast which comprises preparing a yeast nutrient solution and propagating yeast therein with aeration, said yeast nutrient solution being of a dilution corresponding to not

more than 2° on the saccharometer and containing essentially sugar material and yeast nourishing inorganic salts from which components are liberated which tend increasingly to acidify the nutrient solution during propagation, and during the period of propagation neutralizing the deleterious excess of such acidity.

11. The process of manufacturing bakers' yeast which comprises preparing a yeast nutrient solution and propagating yeast therein with aeration, said yeast nutrient solution being of a dilution corresponding to not more than 2° on the saccharometer and containing essentially sugar material and yeast nourishing inorganic salts from which components are liberated which tend increasingly to acidify the nutrient solution during propagation, and during the period of propagation neutralizing the deleterious excess of such acidity by the fractional addition of an innocuous antacid compound.

12. The process of manufacturing yeast which comprises preparing a yeast nutrient solution and propagating yeast therein with aeration, said yeast nutrient solution containing essentially molasses and yeast nourishing inorganic salts from which components are liberated which tend increasingly to acidify the nutrient solution during propagation, and during the period of propagation neutralizing the deleterious excess of such acidity.

13. The process of manufacturing yeast which comprises preparing a yeast nutrient solution and propagating yeast therein with aeration, said yeast nutrient solution containing essentially molasses and yeast nourishing inorganic salts including a compound containing yeast assimilable nitrogen which is adapted to be at least partially assimilated by the yeast and from which during such assimilation components are liberated which tend increasingly to acidify the nutrient solution, and during the period of propagation neutralizing the deleterious excess of such acidity.

14. The process of manufacturing bakers' yeast which comprises preparing a yeast nutrient solution and propagating yeast therein with aeration, said yeast nutrient solution consisting essentially of molasses and yeast nourishing inorganic salts from which components are liberated which tend increasingly to acidify the yeast nutrient solution during propagation, and during the period of propagation neutralizing the deleterious excess of acidity by the addition of an innocuous antacid compound.

15. As an article of manufacture, a yeast product adapted for baking purposes, of which substantially all of the principal constituents have been assimilated during propagation in a nutrient solution consisting of essentially sugar material and yeast nourishing inorganic salts from which components are released tending increasingly to acidify the nutrient solution during propagation, the deleterious excess of such acidity being neutralized during the period of propagation by the addition of an innocuous antacid substance.

In testimony whereof, I have affixed my signature.

FRIEDRICH HAYDUCK.

Certificate of Correction.

It is hereby certified that in Letters Patent No. 1,449,103, granted March 20, 1923, upon the application of Friedrich Hayduck, of Wilmersdorf, Germany, for an improvement in "Processes for the Manufacture of Compressed Yeast," errors appear in the printed specification requiring correction as follows: Page 1, line 44, after the word "acids" insert the word *in;* page 3, line 24, claim 2, for the word "nurtient" read *nutrient;* and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 19th day of June, A. D., 1923.

[SEAL.]

WM. A. KINNAN,
Acting Commissioner of Patents.

Patented Mar. 20, 1923. 1,449,105

UNITED STATES PATENT OFFICE.

FRIEDRICH HAYDUCK, OF WILMERSDORF, GERMANY, ASSIGNOR TO THE FLEISCHMANN COMPANY, OF NEW YORK, N. Y., A CORPORATION OF OHIO.

LOW-ALCOHOL YEAST PROCESS.

No Drawing. Application filed October 30, 1920. Serial No. 420,832.

(GRANTED UNDER THE PROVISIONS OF THE ACT OF MARCH 3, 1921, 41 STAT. L., 1313.)

To all whom it may concern:

Be it known that I, FRIEDRICH HAYDUCK, a citizen of Germany, residing at Wilmersdorf, Germany, have invented certain new and useful Improvements in Low-Alcohol Yeast Processes (for which an application for patent was filed in Germany March 16, 1915, Patent No. 300,662), of which the following is a specification.

This invention relates to a process for the manufacture of yeast and particularly to a process for manufacturing a compressed bakers' yeast in which very little alcohol is produced as a by-product, and has for its object an improved procedure for manufacturing yeast in a more convenient and economical manner than heretofore.

In the manufacture of yeast according to the usual aeration process, large quantities of alcohol are generated, the amount of which is to some extent dependent on the sugar available for the yeast.

Efforts have been made to produce economical conditions under which not only an increase of the yeast yield from the raw material used would be insured, but a simultaneous diminution of the alcohol yield would be obtained. It has therefore already been suggested to dilute the wort to such an extent that the alcohol produced from the sugar could supposedly again be assimilated by the yeast as nourishment. The process disclosed in the German patent to Rainier, 10135, endeavors to reach this goal by adding the nutrient required for the yeast (sugar and peptone), in a manner which would produce this result, i. e., by adding the peptones continuously and the sugar at intervals, as required, and whenever analysis showed the need thereof, stating that in keeping the concentration of the sugar very low the formation of alcohol is prevented and the sugar is used only as a nutrient. In the operations set forth by this patent, the very low concentration of the sugar solution which is added from time to time to the fermenting wort, requires the use of large tanks and apparatus to handle the large volume of liquid. However, the increase in operating costs connected with this high dilution is partly compensated for by the advantage of the high yield in the yeast.

In the process described hereinafter and forming the subject of this invention, the goal of obtaining a high yeast yield with little or no formation of alcohol is reached by the use of worts of normal quality and concentration, the wort being added to the yeast continuously and at a rate such that no large excess of alcohol will be formed, and the yeast can assimilate most of the alcohol which is so formed.

The process may be, for example, executed in the following manner:

A wort adapted for yeast propagation (having, for example, a gravity of 12° Balling) is prepared according to the procedure commonly followed in the compressed yeast industry. A part of this wort is placed in the fermenting vat and is highly diluted (for example, to about 1° Balling), yeast is added thereto and it is aerated. Thereupon the remainder of the concentrated wort is added slowly and substantially continuously throughout a protracted period of time and at a rate such that not only the alcohol which may have been formed from the quantity of sugar present in the diluted portion of the wort, but also any alcohol which may be formed from the sugar which is present in the added wort, can be assimilated immediately by the yeast. If arrangements are made to carry on the aeration process for ten hours, the addition of the wort may be effected for about seven to eight hours under continuous aeration and the aeration may be subsequently continued for two to three hours without the addition of any wort. The quantity of the diluted wort which is originally available for the yeast is so chosen, for example, that the mean content of the entire wort employed would be 3° to 5° Balling.

As compared with the obtaining of yeast from worts of very small concentration, the process described above offers the advantage that the yeast is constantly given new supplies of nutrient constituents necessary for its propagation by the continuous addition of concentrated wort, and that thereby as a result of the continual consumption of the nutrients by the yeast, there is always a wort concentration, by means of which the nutrients and the result-

ant substances are absorbed most efficaciously and quickly by the yeast, that is to say, there is offered in this manner of procedure through the peculiar distribution of the wort, the advantage of great dilution, while the concentration of the wort (calculated for the entire quantity) remains normal.

In the process in accordance with German Patent 10135, the intermittent or continuous addition of the peptones or the intermittent successive addition of sugar to the liquid containing the yeast is provided for by making use of the high dilution, which favors the growth of the yeast at the expense of the formation of alcohol. But, aside from the fact that this process requires constant supervision of the conditions of nutrition obtaining in the liquid, as sugar and peptone can only be added separately and as required, this process does not provide for work with normally concentrated liquids, nor does it disclose the propagation of yeast in a wort of usual constitution, the resultant wort used for the propagation of yeast having a peptone sugar ratio of 2/1. Moreover, the operation of this process requires the estimation of the sugar and peptone content prior to further additions of the respective solutions containing these nutrients, and it therefore lacks the simple operation characterizing the process herein described, which does not differ in any way, in regard to the production of the wort and the amount of labor required, from the usual procedure followed in the manufacture of aerated yeast.

In the manufacture of compressed yeast, the starting of the primary, undiluted wort with yeast, and the adding of the secondary wort, which is being constantly diluted, is a known method, the concentrated wort from the mash process being filtered from the draff and led into the fermenting vat. After a portion of this wort has been run into the vat, the seed yeast is added, and while the thus seeded portion is being aerated the remainder of the concentrated mash is filtered and run into the fermenting vat together with a stream of water, the sparge water being later run into the fermenting vat in the same manner. The amount of water which is constantly run into the vat as the wort is added is so regulated that after all of the concentrated mash wort, the sparge water and the added water have been put into the vat so as to fill the same, the wort will have the required concentration. The conditions for propagating the yeast in the best possible manner are considered to be fulfilled, when all of the filtered wort and sparge water are added in the shortest possible time. It will thus be seen that the propagation begins in a relatively concentrated solution, and that the concentration thereof is decreased gradually, partly because the nutrient substances are being consumed by the yeast and partly because the addition of water and sparge water gradually reduce the initial concentration of the wort. In this procedure, in which, therefore, the opposite principle is followed, such large quantities of alcohol are generated from the very start, that no appreciable assimilation of the alcohol can take place.

Having described my invention what I claim as new and desire to secure by Letters Patent is—

1. A process of propagating yeast which comprises, initiating propagation of yeast in a dilute nutrient solution containing all essential yeast nutrients, aerating the solution, and substantially continuously adding during the period of propagation, a solution containing all essential yeast nutrients.

2. A process of propagating yeast which comprises, preparing a wort containing all essential yeast nutrients in solution, initiating propagation of yeast in a diluted portion of said wort, and substantially continuously adding during the period of propagation, the wort of higher concentration.

3. A process of propagating yeast which comprises, preparing a wort containing all essential yeast nutrients in solution, initiating propagation of yeast in a diluted portion of said wort, aerating the diluted portion, and substantially continuously adding during the period of propagation, the wort of higher concentration.

4. A process of propagating yeast with a relatively low yield of alcohol which comprises preparing a wort containing all essential yeast nutrients in solution, initiating propagation of yeast in a diluted portion of said wort, aerating the diluted portion, and substantially continuously adding during the period of propagation, a wort of higher concentration, at a rate such that the yeast may propagate and substantially all of the alcohol which may be formed is assimilated by the yeast.

5. A process of propagating yeast with a relatively low yield of alcohol which comprises, preparing a wort containing all essential yeast nutrients in solution, initiating propagation of yeast in a diluted portion of said wort, aerating the diluted portion, and slowly and substantially continuously adding during the period of propagation, the wort of higher concentration.

6. A process of propagating yeast with a relatively low yield of alcohol which comprises, preparing a wort containing all essential yeast nutrients in solution, initiating propagation of yeast in a diluted portion of said wort, aerating the diluted portion and slowly and substantially continuously adding the wort of high concentration, which

addition is effected until near the end of the period of propagation.

7. A process of propagating yeast which comprises, preparing a dilute wort and a relatively concentrated wort, each containing all essential yeast nutrients in solution, initiating propagation of yeast in the dilute wort, aerating the dilute wort and substantially continuously adding during the period of propagation, the wort of higher concentration.

8. A process of propagating yeast with a relatively low yield of alcohol which comprises, preparing a wort containing all essential yeast nutrients in solution, initiating propagation of yeast in a diluted portion of said wort, aerating the diluted portion, and substantially continuously adding during the period of propagation, the wort of higher concentration at a rate such that the yeast may propagate and substantially all of the alcohol which may be formed is assimilated by the yeast.

9. A process of propagating yeast with a relatively low yield of alcohol which comprises, preparing a wort containing all essential yeast nutrients in solution, initiating propagation of yeast in a diluted portion of said wort, aerating the diluted portion, and substantially continuously adding during the period of propagation, the wort of higher concentration at a rate such that the concentration of the dilute wort does not rise above that at which substantially all of the alcohol which may be formed, will be assimilated by the yeast.

10. A process of propagating yeast with a relatively low yield of alcohol which comprises, preparing a wort containing all essential yeast nutrients in solution, initiating propagation of yeast in a highly diluted portion of said wort, aerating the diluted portion, and substantially continuously adding during the period of propagation, the wort of higher concentration at a rate such that the concentration of the dilute wort remains substantially constant, whereby substantially all of the alcohol which may be formed is assimilated.

In testimony whereof, I have affixed my signature.

FRIEDRICH HAYDUCK.

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PLAINTIFF'S EXHIBIT P-3.

Patented Mar. 20, 1923. **1,449,106**

UNITED STATES PATENT OFFICE.

FRIEDRICH HAYDUCK, OF WILMERSDORF, GERMANY, ASSIGNOR TO THE FLEISCHMAN COMPANY, OF NEW YORK, N. Y., A CORPORATION OF OHIO.

LOW-ALCOHOL YEAST PROCESS.

No Drawing. Application filed October 30, 1920. Serial No. 420,833.

(GRANTED UNDER THE PROVISIONS OF THE ACT OF MARCH 3, 1921, 41 STAT. L., 1313.)

To all whom it may concern:

Be it known that I, FRIEDRICH HAYDUCK, citizen of Germany, residing at Wilmersdorf, Germany, have invented certain new and useful Improvements in Low-Alcohol Yeast Processes (for which application for patent was filed in Germany March 19, 1915, Patent No. 303,222), of which the following is a specification.

This invention relates to a process for the manufacture of yeast and particularly to a process for manufacturing a compressed bakers' yeast in which very little alcohol is produced as a by-product and has for its object an improved procedure for manufacturing yeast in a more convenient and economical manner than heretofore.

In accordance with the process protected by my German Patent 300,662 and set forth in my corresponding copending application for United States Patent Serial No. 420,832, filed Oct. 30, 1920, a high yeast yield is obtained at the expense of the production of alcohol, in worts of normal concentration, by starting the growth of the yeast in a very weak solution and thereafter adding concentrated wort slowly and substantially continuously, whereby, as a result of the constant consumption of the nutrients and the resultant alcohol on the part of the yeast, in spite of the addition of concentrated wort, there is always a sufficiently low concentration of nutrients and yeast conversion products. For the carrying out of this process the use of yeast wort of normal quality is contemplated.

In the process described hereinafter, which constitutes the subject-matter of my present invention, this peculiar distribution of the nutrient liquid is applied to worts, which are prepared principally from sugar or sugar containing substances (for example, molasses), and inorganic salts. In the production of yeast from such saccharifierous solutions, containing mineral salts as yeast nutrients, the difficulty has hitherto always been encountered that the yeast cannot stand such high salt concentrations as are required for its full nourishment in yeast nutrient solutions of heretofore usual sugar content, and that it was therefore necessary, to work either with greatly diluted nutrient liquids or solutions or with solutions containing a disproportionately small quantity of inorganic yeast-nutrient salts. The latter procedure, however, results in correspondingly small yeast yields because of the deficiency of most essential substances or elements for which the yeast was dependent upon the inorganic salts.

By applying the hereinafter described process of "adding," the results are attained that owing to the appropriate gradual addition of nutrients at the desired rate, there is not only avoided an accumulation of alcohol, but also deleterious accumulation of nutrient salts is avoided, as the salts, as well as substantially all resulting alcohol which may be formed, are immediately assimilated by the yeast. The manipulative operation of the process is the same as described in German Patent 300,662 and in the aforesaid corresponding copending application for United States Patent Serial No. 420,832.

For the preparation of the nutrient solutions there are used, for instance, sugar and yeast-nutrient inorganic salts (ammonium, potassium and magnesium combined with phosphoric acid, sulphuric acid, etc.). This process permits of the use of the salts in a proportion up to half as much total salts as sugar. When using ammonium sulphate as a nitrogen source, the rapid assimilation of the nutrient salts supplied for the yeast can be recognized by the surprisingly great increase in acid content (sulphuric acid ions set free) in the nourishing liquid. The deleterious excess of this liberated acid can be eliminated by the addition of alkalies or salts having an alkaline reaction in accordance, for example, with the process of my copending application for United States Patent Serial No. 420,830.

The process, for example, may be suitably carried out in the following manner:

To 100 parts of sugar there are used: 40 parts of ammonium sulphate, 9 parts acid phosphate of potassium, 1 part magnesium sulphate, to which is to be added, about 30 parts calcium carbonate for the neutralization.

To 100 parts molasses (with 50 per cent

sugar content), there are used: 10 parts ammonium sulphate, 10 parts superphosphate (having 18% water soluble phosphoric acid), 0.5 parts magnesium sulphate, to which is to be added about 4 parts calcium carbonate.

The raw nutrient materials are dissolved in sufficient water so that the sugar content of the solution amounts to about 10 percent. As soon as the yeast is brought into the fermenting vat with a part of the nutrient solution, which has been previously diluted as will be hereinafter described aeration and the addition of the remaining nutrient solution is started. Carrying out the process of the present invention in a manner similar to that described in my copending application for United States Patent Serial No. 420,832, the seed yeast may be added in the first instance to a solution of a strength of about 1° Balling and containing also a proportionate amount of nutrient salts which are used, and thereafter during the growth of the yeast the solution containing about 10% of sugar and a proportionate quantity of the nutrient salts, may be added slowly and substantially continuously so as to maintain the concentration of about the solution in which the yeast is propagating approximately constant or at a slightly greater or less concentration during the main portion of the period of propagation. The calcium carbonate or chalk is either all added at the beginning or, in accordance with the increase in acidity, gradually, to the fermenting vat. One can also distribute the yeast in the beginning in water in the fermenting vat, and then gradually and substantially continuously add the nutrient solution as described. It will be seen that the liquid in which the yeast is suspended should be non-toxic to the yeast. After all the nutrient solution has been added, the aeration is continued and the propagation is concluded in the well known manner, the yeast being thereafter separated from the finally attenuated nutrient solution wherein it has been grown.

Although my process is not limited to any particular duration of the period of yeast propagation, which may vary within considerable limits and may comprise such periods as are deemed proper or found most desirable in accord with the facilities and results desired in a particular yeast manufacturing establishment, it has been found, as stated in my German Patent No. 300,662, that if an aeration period totalling about 10 hours is employed, the gradual addition of the nutrient solution to the aerated solution as described may cover a period of 7 to 8 hours followed by a period of 2 to 3 hours aeration after this gradual addition is completed. The rate of addition and the duration of the process may be determined in accordance with tests so that the concentration remains approximately constant and at such a degree of dilution that accumulation of alcohol in the solution is substantially prevented, owing to the fact that in such dilute solution any alcohol which may be formed is again assimilated by the yeast, and an especially efficient utilization of the nutrient substances for obtaining a high yield of yeast in the process is thus attained.

Having described my invention what I claim as new and desire to secure by Letters Patent, is:

1. A process of propagating yeast which comprises preparing a nutrient solution comprising essentially sugar material and yeast nourishing inorganic salts, suspending seed yeast in a non-toxic aqueous liquid, aerating the liquid, and substantially continuously adding the nutrient solution.

2. A process of propagating yeast with a relatively low yield of alcohol which comprises preparing a nutrient solution, exclusive of cereal material, comprising essentially sugar material and yeast nourishing inorganic salts, suspending seed yeast in a non-toxic aqueous liquid, aerating the liquid, and substantially continuously adding the nutrient solution.

3. A process of preparing yeast with a relatively low yield of alcohol which comprises suspending seed yeast in a non-toxic aqueous liquid, aerating the liquid, and substantially continuously adding thereto sugar material and yeast nourishing inorganic salts at a rate such that the concentration of the aerated liquid does not arise above that at which substantially all of the alcohol which may be formed is assimilated by the yeast.

4. A process of propagating yeast with a relatively low yield of alcohol which comprises suspending seed yeast in a non-toxic aqueous liquid, aerating said liquid, substantially continuously adding thereto sugar material and yeast nourishing inorganic salts from which components are liberated which tend increasingly to acidify the solution during propagation, which addition is at a rate such that the concentration of the aerated liquid does not arise above that at which substantially all of the alcohol which may be formed is assimilated by the yeast, and during the period of propagation neutralizing the deleterious excess of such acidity.

5. A process of propagating yeast with a relatively low yield of alcohol which comprises suspending seed yeast in a non-toxic aqueous liquid, aerating said liquid, substantially continuously adding thereto sugar material and yeast nourishing inorgan[illegible]

salts from which components are liberated which tend increasingly to acidify the solution during propagation, which addition is at a rate such that the concentration of the aerated liquid does not rise above that at which substantially all of the alcohol which may be formed is assimilated by the yeast, and during the period of propagation neutralizing the deleterious excess of such acidity, by the fractional addition of an innocuous antacid substance.

6. A process of propagating yeast with a relatively low yield of alcohol which comprises preparing a nutrient solution comprising essentially sugar material and yeast nourishing inorganic salts from which components are liberated which tend increasingly to acidify the solution during propagation, suspending seed yeast in a non-toxic aqueous liquid, aerating the liquid, substantially continuously adding the nutrient solution to the aerated liquid, and adding during the period of propagation an innocuous antacid substance adapted to neutralize at least a substantial portion of such acidity.

7. A continuous process of propagating yeast with a relatively low yield of alcohol which comprises preparing a nutrient solution, exclusive of cereal material, comprising essentially sugar material and yeast nourishing inorganic salts from which components are liberated which tend increasingly to acidify the solution during propagation, suspending seed yeast in a non-toxic aqueous liquid, aerating the liquid, thereafter substantially continuously adding the nutrient solution to the aerated liquid, and during the period of propagation neutralizing the deleterious excess of such acidity.

8. A process of propagating yeast with a relatively low yield of alcohol which comprises preparing a nutrient solution comprising essentially sugar material and yeast nourishing inorganic salts from which components are liberated which tend increasingly to acidify the solution during propagation, suspending seed yeast in a non-toxic aqueous liquid, aerating the liquid, substantially continuously adding the nutrient solution to the aerated liquid, and during the period of propagation neutralizing at least a substantial portion of such acidity, by the fractional addition of an innocuous antacid substance.

9. A process of propagating yeast with a relatively low yield of alcohol which comprises initiating propagation of yeast in a highly dilute nutrient solution consisting essentially of water, sugar material, and yeast nourishing inorganic salts, aerating the solution, and gradually and substantially continuously adding thereto a more concentrated aqueous solution of sugar material and yeast nourishing inorganic salts, the total amount of yeast nourishing inorganic salts used in the process amounting to about one-half of the total amount of sugar used.

10. A process of propagating yeast with a relatively low yield of alcohol which comprises preparing a nutrient solution containing essentially sugar material and yeast nourishing inorganic salts, the total amount of yeast nourishing inorganic salts used being about one-half of the total amount of sugar used, highly diluting a portion of the nutrient solution, initiating propagation of yeast therein with aeration, and during the period of propagation slowly and substantially continuously adding the concentrated solution.

11. A process of propagating yeast with a relatively low yield of alcohol which comprises preparing a nutrient solution containing essentially sugar material and yeast nourishing inorganic salts from which components are liberated which tend increasingly to acidify the nutrient solution during propagation, the total amount of yeast nourishing inorganic salts used being about one-half of the total amount of sugar used, highly diluting a portion of the nutrient solution, initiating propagation of yeast therein with aeration, during the period of propagation slowly and substantially continuously adding the concentrated solution, and neutralizing a substantial portion of such acidity by the addition of an innocuous antacid substance.

12. A process of propagating yeast with a relatively low yield of alcohol which comprises initiating propagation of yeast in a dilute nutrient solution comprising essentially sugar material and yeast nourishing inorganic salts, aerating the solution, and adding thereto substantially continuously during the period of propagation a solution containing sugar material and yeast nourishing inorganic salts at a rate such that the concentration of the solution in which the yeast is propagating is maintained substantially constant.

13. A process of propagating yeast with a relatively low yield of alcohol which comprises initiating propagation of yeast in a dilute nutrient solution comprising essentially sugar material and yeast nourishing inorganic salts, from which components are liberated which tend increasingly to acidify the nutrient solution during propagation, aerating the solution, during the period of propagation adding thereto substantially continuously sugar material and yeast nourishing inorganic salts, at a rate such that the concentration of the solution in which the yeast is propagating is maintained substantially constant, and during the period of propagation neutralizing a substantial portion of such acidity by the addition of an innocuous antacid substance.

14. The process of propagating yeast which comprises initiating the yeast growth in a dilute aqueous solution comprising essentially sugar material and yeast nourishing inorganic salts, aerating the solution and adding thereto gradually and continuously, and at least during the major portion of the period of yeast propagation therein, a yeast nutrient solution containing essentially sugar material and yeast nourishing inorganic salts, the salt content of the solutions being approximately one-half the sugar content.

15. A process of propagating yeast which comprises initiating the propagation of yeast in a highly dilute nutrient solution comprising essentially water, molasses and yeast nourishing inorganic salts from which, during propagation, components are liberated which tend increasingly to acidify the nutrient solution, aerating the solution, and during the period of propagation adding to the solution a more concentrated aqueous solution of molasses and yeast nourishing inorganic salts, and sufficient quantities of an innocuous antacid substance to neutralize at least a substantial portion of such acidity.

16. A process of propagating yeast which comprises initiating the propagation of yeast in a dilute aqueous yeast nutrient solution containing sugar material and yeast nourishing inorganic salts from which, during propagation, components are liberated which tend increasingly to acidify the nutrient solution, aerating the solution, adding to the nutrient solution containing the yeast, during at least a portion of the period of propagation, additional sugar and material and yeast nourishing inorganic salts, the proportion of total inorganic salts employed during the entire period of propagation being approximately one-half the total quantity of sugar employed, and during the period of propagation, neutralizing at least a portion of such acidity.

In testimony whereof, I have affixed my signature.

FRIEDRICH HAYDUCK.

Certificate of Correction.

It is hereby certified that in Letters Patent No. 1,449,106, granted March 20, 1923, upon the application of Friedrich Hayduck, of Wilmersdorf, Germany, for an improvement in "Low-Alcohol Yeast Processes," errors appear in the printed specification requiring correction as follows: Page 2, line 12, after the word "solution" strike out the comma and insert the same to follow the word "described" in line 13; same page, line 29, strike out the word "about"; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 29th day of May, A. D., 1923.

[SEAL.]

KARL FENNING,
Acting Commissioner of Patents.

11 Ballen

PLAINTIFF'S EXHIBIT P-4.

Patented Mar. 20, 1923. 1,449,109

UNITED STATES PATENT OFFICE.

FRIEDRICH HAYDUCK, OF WILMERSDORF, GERMANY, ASSIGNOR TO THE FLEISCHMANN COMPANY, OF NEW YORK, N. Y., A CORPORATION OF OHIO.

LOW-ALCOHOL YEAST PROCESS.

No Drawing. Application filed October 30, 1920. Serial No. 420,836.

(GRANTED UNDER THE PROVISIONS OF THE ACT OF MARCH 3, 1921, 41 STAT. L., 1313.)

To all whom it may concern:

Be it known that I, FRIEDRICH HAYDUCK, a citizen of Germany, residing at Wilmersdorf, Germany, have invented certain new and useful Improvements in Low-Alcohol Yeast Processes (for which application for patent was filed in Germany April 23, 1915, Patent No. 304,243), of which the following is a specification.

This invention relates to a process for the manufacture of yeast, and particularly to a process for manufacturing a compressed "bakers" yeast in which very little alcohol is produced as a by-product and has for its object an improved procedure for manufacturing yeast in a more convenient and economical manner than heretofore.

In accordance with the process described in my German Patent 303,222, and in my corresponding application for United States Patent, Serial No. 420,833, filed October 30, 1920, a particularly high yeast yield is obtained, at the expense of the production of alcohol by a process in which nutrient solutions, which have been produced from sugar or sugar-containing substances and yeast-nutrient inorganic salts are added so gradually during the yeast propagation or growth that the yeast can immediately assimilate the nutrients which may be present together with substantially all of the alcohol which may be formed, under constant aeration.

In the preferred embodiment of my invention described and claimed in my aforesaid application, Serial No. 420,833, the seed yeast is added either to water or to a very dilute nutrient solution and there is gradually and substantially continuously added a relatively concentrated solution of yeast-nutrient materials, as for example, 10% of sugar together with a proportionate amount of suitable inorganic yeast nutrient salts which may be as high as up to one-half of the amount of sugar. Such solutions may have the following proportions:

Sugar 100 parts, ammonium sulphate 40 parts, acid potassium phosphate 9 parts, magnesium sulphate 1 part, calcium carbonate, for neutralization about 30 parts and sufficient water to form a solution containing about 10% of sugar: or

Molasses (containing about 50% sugar) 100 parts, ammonium sulphate 10 parts, Superphosphate (having 18% water soluble phosphoric acid) 10 parts, magnesium sulphate 0.5 parts, calcium carbonate about 4 parts and sufficient water to form a solution containing about 10% sugar.

In the above process I have further discovered that it is necessary for obtainment of otherwise unobtainable high yields of yeast to neutralize or bind the acid components set free from the inorganic salts by the yeast by the addition of alkalies or alkaline salts. The acid components, which are here set free and must be neutralized, represent in regard to the manufacture of yeast, as I have discovered, a largely harmful ballast.

As I have further discovered, a distinct industrial advantage is obtained if it is possible to use the alkalies themselves for the growth of yeast. In this case not only is there a conservation, at least in part, of the acids which are commercially required for the production of such nutrient salts as are used in the process of my aforesaid copending application Serial No. 420,833, but also there is an economizing of the alkalies which are commercially used to neutralize the said acids in the manufacture of the salts, and which in my process are required to neutralize the continuously liberated acid components in the manufacture of yeast. As is also apparent from my German Patent No. 304,242, and my corresponding application for United States patent, Serial No. 420,837, filed October 30, 1920, such a process can be carried out with suitable free alkalies in an assuredly successful manner.

I have now found that such a process in regard to the use of alkalies or salts having an alkaline reaction can be carried out most effectively, if a small quantity of such inorganic nutrient salts are added at the very beginning to that portion of the nutrient solution to which is added the pitch or seed yeast, and from which the yeast in the process of utilization of certain portions of the salts sets free acid ions. In this case the added alkalies neutralize and are in turn neutralized by the acid so produced, thereby making the nutrient solution safe for the yeast.

The process for example is carried out in the following manner: The nutrients required for the yeast (sugar and inorganic

salts, but exclusive of ammonium salts or other source of inorganic nitrogen) are first dissolved in water to form a solution containing approximately 10% of sugar material. A part of this solution, after being properly diluted with water, in general accordance with the process of my aforesaid copending application Serial No. 420,833 (modified as particularly described in the present application i. e., by the omission of the ammonium salts and substance having an alkaline reaction) is mixed with some ammonium sulphate and set on with seed yeast. The remainder of the nitrogenous substance required for supplying necessary yeast assimilable nitrogen for the yeast, is added in the form of free ammonia (ammonia water), to the relatively concentrated nutrient solution, which is gradually and substantially continuously added to the more dilute nutrient solution during propagation of the yeast. The addition is regulated preferably so that the ammonia can always be neutralized to full extent by the acids set free by the yeast. With such regulation a condition of not more than a limited acidity which is adapted for the yeast growth is maintained in the solution wherein the yeast is grown.

The process of adding ammonium salts to mashes or worts for the nourishment of the yeast, and of neutralizing the lactic acid formed by lactic fermentation in mashes prior to the fermentation by the yeast, by means of alkalies, especially ammonia, is known. See, for example the United States patent to Alfred Pollak, No. 1,123,920, issued January 5, 1915. In contrast to this, the process of my present application has for its object and comprises in its specific embodiment particularly the addition of alkalies or salts having an alkaline reaction to the nutrient as yeast nourishment, for the production of a high yield of yeast of good quality and in this process one and the same quantity of inorganic acids (repeatedly neutralized and reliberated from their salts during the yeast propagation or growth) constantly neutralizes the added free alkalies or salts having an alkaline reaction as they are gradually added with the concentrated wort. The alkaline substance thus gradually added is, as above described, preferably a substance such as ammonia or ammonia water which not only serves to neutralize acidity developed from the selective partial utilization of the inorganic yeast nutrient salts present but also serves to supply yeast-assimilable nitrogen requisite for the production of large yields of yeast of good quality.

The quantity of ammonium sulfate which, as above described, is suitably employed in preparing the nutrient solution may be such a quantity as is proportionate to the other inorganic salts which are at the time of its introduction present in the relatively dilute solution in which the yeast growth is taking place or is to take place. That is to say, if, for example, the yeast growth is started in a solution containing 1% of sugar (as described in my above-mentioned copending application Serial No. 420,833 on which the invention of my present application is in part based), a proportionate quantity of ammonium sulfate may suitably be used approximating one-fifth to four-tenths this amount of sugar (in accord with the exemplary formulas hereinbefore given) in which case the yeast-nutrient solution would contain initially 0.2% to 0.4% ammonium sulfate together with the proportionate quantities of non-nitrogenous yeast-nutrient substances. Thereafter, during the course of yeast propagation, the yeast-nutrient solution is aerated and the nutrients consumed by the yeast are replenished (so gradually as to permit utilization of any alcohol as formed and to prevent any substantial accumulation of alcohol in the nutrient solution) by the addition of a more concentrated solution which may as hereinbefore described contain for example about 10% sugar and proportionate amounts of the other yeast-nutrient salts. The procedure of my present invention, which discloses the progressive addition of an antacid substance supplying yeast assimilable nitrogen (e. g., ammonia water) to a dilute wort containing a salt or salts from which, during the period of propagation, components are liberated which tend to increasingly acidify the solution in which the yeast is propagated, differs from that of my copending application Serial No. 420,833, which shows the progressive addition of an acid-liberating nitrogen-supplying salt or salts, for example, ammonium sulphate, the deleterious excess of acid being neutralized by non-nitrogenous neutralizing agent. The use of an antacid nitrogenous substance disclosed in the present process serves to prevent deleterious increase of acidity during the yeast production and, as I have discovered, enables high yields of good quality yeast to be obtained, while at the same time effecting a saving in the amount of nutrient salts used.

Since the ammonia water or similar substance having an alkaline reaction and supplying yeast-assimilable nitrogen serves in the present process as the acid-neutralizing agent, it is of course apparent as is pointed out above that the calcium carbonate used in the typical illustrative formulas hereinbefore given and taken from my copending application for United States patent Serial No. 420,833 will not be used as described in

my said copending application but that the ammonia water or equivalent substance herein referred to will be used in the manner and for the purposes described.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. A continuous process of propagating yeast which comprises, initiating propagation of yeast in a dilute nutrient solution containing a compound which is at least partially assimilable by yeast and from which, while being so assimilated, components are liberated which tend increasingly to acidify the nutrient solution, aerating the solution, and adding thereto during the process of propagation yeast nutrient materials, including a sufficient amount of a substance having an alkaline reaction and containing yeast assimilable nitrogen to neutralize substantially all of such acidity.

2. A continuous process of propagating yeast which comprises, initiating propagation of yeast in a dilute nutrient solution containing a compound which is at least partially assimilable by yeast and from which, while being so assimilated, components are liberated which tend increasingly to acidify the nutrient solution, aerating the solution, and adding thereto during the process of propagation yeast nutrient materials, including a substance having an alkaline reaction and containing yeast assimilable nitrogen, at a rate such as to maintain the concentration of the solution substantially constant and to neutralize substantially all of such acidity.

3. A continuous process of propagating yeast with a relatively low yield of alcohol which comprises, initiating propagation of yeast in a highly dilute nutrient solution containing a compound which is at least partially assimilable by yeast and from which, while being so assimilated, components are liberated which tend increasingly to acidify the nutrient solution, aerating the solution, and adding thereto during the process of propagation a more concentrated solution of yeast nutrient materials, including a substance having an alkaline reaction and containing yeast assimilable nitrogen, at a rate such as to maintain a concentration of the solution substantially constant and to neutralize substantially all of such acidity.

4. A continuous process of propagating yeast which comprises, initiating propagation of yeast in a dilute nutrient solution containing a compound which is at least partially assimilable by yeast and from which, while being so assimilated, components are liberated which tend increasingly to acidify the nutrient solution, aerating the solution, and adding thereto during the process of propagation a more concentrated solution of yeast nutrient materials, including a sufficient amount of ammonium hydrate to neutralize substantially all of such acidity.

5. A continuous process of propagating yeast with a relatively low yield of alcohol which comprises, initiating propagation of yeast in a highly dilute nutrient solution containing a compound which is at least partially assimilable by yeast and from which, while being so assimilated, components are liberated which tend increasingly to acidify the nutrient solution, aerating the solution, and adding thereto during the process of propagation a more concentrated solution of yeast nutrient materials including ammonium hydrate, at a rate such as to maintain the concentration of the solution substantially constant and to neutralize substantially all of such acidity.

6. A continuous process of propagating yeast with a relatively low yield of alcohol which comprises, preparing a dilute nutrient solution containing sugar material and an ammonium compound from which yeast may assimilate nitrogen and from which, during such assimilation, components are liberated which tend increasingly to acidify the nutrient solution, initiating propagation of yeast therein with aeration, and substantially continuously adding during the period of propagation a nutrient solution containing sugar material and a compound having an alkaline reaction and containing yeast assimilable nitrogen, at a rate such that the concentration of the aerated solution is maintained approximately constant and substantially all of such acidity is neutralized.

7. A continuous process of propagating yeast with a relatively low yield of alcohol which comprises, preparing a dilute nutrient solution containing sugar material and an ammonium compound from which yeast may assimilate nitrogen and from which, during such assimilation, components are liberated which tend increasingly to acidify the nutrient solution, initiating propagation of yeast therein with aeration, and substantially continuously adding during the period of propagation a nutrient solution containing sugar material and ammonium hydrate, at a rate such that the concentration of the aerated solution is maintained approximately constant and substantially all of such acidity is neutralized.

8. A continuous process of propagating yeast with a relatively low yield of alcohol which comprises, preparing a dilute nutrient solution containing sugar material and an ammonium compound from which yeast may assimilate nitrogen and from which, during such assimilation, components are liberated which tend increasingly to acidify the nutrient solution, initiating propagation of yeast therein with aeration.

and substantially continuously adding during the period of propagation a more concentrated nutrient solution containing sugar material and a compound having an alkaline reaction and containing yeast assimilable nitrogen, the addition being made at such a rate, and the relative proportions of the ammonium compound originally present in the dilute solution, the sugar material and the compound having an alkaline reaction, being such, that substantially all of such acidity is neutralized and the concentration of the solution in which the yeast is propagating is maintained approximately constant, whereby practically all alcohol which may be formed is assimilated by the yeast.

In testimony whereof, I have affixed my signature.

FRIEDRICH HAYDUCK.

PLAINTIFF'S EXHIBIT P-5.

Patented June 12, 1928. 1,673,735

UNITED STATES PATENT OFFICE.

ROBERT L. CORBY, OF NEW YORK, AND WILHELM H. F. BÜNRIG, OF MOUNT VERNON, NEW YORK, ASSIGNORS TO THE FLEISCHMANN COMPANY, OF NEW YORK, N. Y., A CORPORATION OF OHIO.

PROCESS FOR THE MANUFACTURE OF YEAST.

No Drawing. Application filed August 16, 1926. Serial No. 728,867

This invention relates to a process for the manufacture of yeast, especially baker's yeast, and more particularly to an improved method of carrying out a process of manufacturing yeast in which at least a portion of the yeast nutrient is added after the propagation of yeast has begun.

An object of this invention is to provide an improved procedure for the manufacture of yeast in an efficient, convenient and economical manner.

In its more specific aspects one of the objects of this invention is to provide a method of carrying out a process of manufacturing yeast in which the amounts of the added constituents are regulated in such a manner that the capacity of fermenters and other propagating apparatus is materially increased and large yields of yeast are obtained.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the several steps and the relation and order of one or more of such steps with respect to each of the others thereof, which will be exemplified in the process hereinafter disclosed, and the scope of the application of which will be indicated in the claims.

In the art of yeast manufacture there has been a constant endeavor to obtain a yeast having better baking qualities and at the same time to increase the quantity of yeast which may be obtained from a given amount of materials and thereby decrease the net production cost.

Nutrient solutions for the propagation of yeast may be of a type prepared from all cereal material, from sugar material, together with suitable yeast nourishing inorganic compounds such, for example, as compounds containing yeast-assimilable nitrogen and phosphorus adapted to be utilized during yeast growth, or from a combination of the materials of these two types of nutrient solutions. The amount of yeast to be obtained by propagation in any of the above types of nutrient solutions is somewhat dependent upon the environment prevailing in the propagating vat or fermenter, which environment involves various factors such as the amount of aeration, the temperature and the density of the nutrient solution.

In the prior practice of yeast propagation, particularly in nutrient solutions containing sugar material and yeast-nutrient inorganic compounds, that is, a solution of the "sugar-salt" type, the control of the environment has been carried to a comparatively high order and fluctuations in the acidity of the solution were carefully minimized, suitable corrective agents being added whenever the desired limits were exceeded. For example, ammonium hydroxide has been used as an agent to depress undue acidity, particularly released acidity, while a suitable acid of an organic or inorganic nature, such as for example phosphoric, sulphuric or lactic acid has been used when necessary to maintain the acidity.

In order adequately to control the temperature it has been customary to provide the fermenter with a suitable cooling means, for example, an interiorly disposed cooling coil. During a portion of the propagation there may be a tendency for the temperature to rise in the fermenter. In consequence a gradually increasing circulation of the cooling medium in the cooling coil was generally practiced.

The condition of the nutrient solution has thus been controlled by making suitable readings at regular intervals and by employing when necessary suitable corrective measures, as the conditions indicate.

A nutrient solution of relatively high dilution, especially in the use of the so-called sugar-salt type of solutions, has been found to be preferable, such dilution having been attained either by initial dilution of the entire nutrient solution or by suspending the seed yeast in a diluted portion thereof or other aqueous liquid non-toxic to yeast and slowly and substantially continuously adding the remaining and more concentrated solution. Such last mentioned type of process is known alternately as a "continuous", an "addition", or a "continuous addition" process. In either case, since the entire amount of the dilute nutrient solution is present in

the fermenter at the end of the process, relatively large fermenters have been required in order to obtain a given yield of yeast.

In the practice of the present invention, an environment is created and substantially maintained which is favorable to the propagation of large yields of yeast, at the same time using smaller apparatus than was heretofore possible with the use of the very dilute nutrient solutions now generally deemed preferable. This is achieved by the use of a fermenter, in which propagation is started, containing initially only a portion of the nutrient material from which a given batch of yeast is to be manufactured. During the period of propagation further nutrient material is added in a manner conducive to the prolific multiplication of yeast in the fermenter, as more fully set forth hereinafter.

To this end the nutrient solution is first prepared in a relatively concentrated condition. In case all the nutrient material is not contained initially in the prepared solution, supplemental nutrient material may be added, some to the portion first placed in the fermenter and the balance during the supplying of the solution run in during the course of propagation. The nutrients to be added thus may if desired be in solution.

In the preparation of the nutrient solution it should be the object to bring it to a condition favorable to yeast propagation. In the case of solutions of the sugar-salt type, this involves particularly the treatment of the sugar material in a manner so as to remove as far as practicable, all foreign material which may have a deleterious influence upon the yeast. For example, where molasses is the sugar material to be employed, this preliminary treatment is preferably such as to produce a clear, rapidly filtering solution giving a clear filtrate. Such treatment may comprise any suitable method and may involve heating, filtering and the addition of one or more clarifying agents.

A portion of the nutrient solution when prepared is placed in the fermenter and a properly tempered diluent, for example, water, both hot and cold, run in until the dilution, temperature and density are brought initially to the points adapted for the prolific multiplication of yeast after which the fermenter is preferably stocked with a relatively large amount of suitable seed yeast. The balance of the prepared solution which is in a relatively concentrated condition is placed in a supply reservoir so that it can be run into the fermenter during the period of propagation in such quantities and at such times as desired, the solution in the fermenter being continuously aerated during substantially the whole of such period.

Prolific propagation of yeast is here induced throughout the propagating period by regulating the addition of nutrients to the fermenter in such a manner as highly to stimulate the propagation of yeast without unduly raising the concentrations of the nutrient materials in solution at any time to a point which tends to become toxic to the yeast. The rate here practiced, however, is substantially in excess of that heretofore possible because of the stimulated activity of yeast. A materially increased activity of the yeast is attained at the beginning by the employment of temperature conditions within the fermenter which have heretofore been deemed impracticable. In the heretofore known processes of manufacturing yeast, the fermenter has been stocked while the fermenter is being filled and somewhat before the final dilution has been attained, and at a temperature of from 22°–25° C., and during the first few hours of the propagation the temperature has been allowed gradually to rise to a maximum of 30° C. In the present process, however, the temperature initially employed during a portion of at least one of the stages of propagation is much higher than heretofore and may be for example from 30°–35° C. or even up to the thermal death point of the yeast in a sugar solution. Moreover, contrary to the usual practice, this temperature is gradually lowered during the first hours of the stage of propagation until a temperature of 30° C. has been reached and is thereafter maintained approximately constant, the interval of time during which the high temperature is maintained being inversely proportional to the temperature.

As the propagation progresses, the presence in the nutrient solution both of the yeast cells themselves and the residual substances in the nutrient solution, either of an unassimilated or eliminated character, tend to increase the density and the toxicity generally prevailing in the nutrient solutions, whereas the relative concentrations of the nutrients present may or may not have changed. As propagation is here instituted under conditions particularly favorable to large yields of yeast, certain of the starting conditions are, in accordance with the practice of this invention, periodically approximately restored at intervals whenever such undesirable conditions are reached. For example, fluctuation in the acidity may be compensated from hour to hour by the addition of suitable antacid reagents, particularly those containing yeast assimilable nitrogen, and at intervals generally of several hours, "addition" is diminished or stopped, a substantial portion of the content of the fermenter is withdrawn and thereafter water, both warm and cold, is again added to the fermenter until certain of the starting conditions, particularly dilution, are substantially restored.

As the fermenter is not completely

drained, there remains, of course, a very substantial amount of yeast in the fermenter which serves as seed yeast for the next succeeding stage of the propagation. Furthermore, if desired, in order to increase the amount of seed yeast present, a portion of the yeast separated or pressed from the preceding stage may be added at the beginning of any subsequent stage. The total period of propagation practiced in this way may continue for from 12 to 24 or more hours. The interval at which yeast is to be drawn off, will, of course, preferably be some submultiple of the total period of propagation, such as for example, from 4 to 6 or 8 hours as conditions warrant.

It will be perceived that by this intermittent drawing off, fermenters of less total capacity may be employed than was heretofore possible, for a given yield of yeast. The reservoir, however, is preferably proportioned to contain the nutrient which is to be supplied during each stage of the propagating period. It will also be perceived that since the reserve reservoir contains the nutrient for the regulated additions in a relatively concentrated form, that less space is occupied by the main mass than would be required if it were diluted in toto in a fermenter. This process therefore includes the regulated supplying of further nutrient from an outside source to a fermenter and at suitable intervals drawing off yeast preferably accompanied by temporary diminution or cessation of "addition". Yeast is separated from the withdrawn solution cooled and ultimately pressed in the usual manner. Large yields of yeast, for example, yields approximating 85% and over, based on the sugar material employed, (assuming such sugar material to contain 50% fermentable sugars) may be obtained in the practice of this process. By the utilization of the principles set forth a greater amount of yeast may be produced from a given amount of material in a given time than was heretofore practical. The following is an example of the manner in which the process of this invention may be practiced:

The desired quantity of sugar material such as molasses of any suitable type for example, cane or beet molasses or a mixture thereof is treated in any suitable manner so as to yield a clear, rapidly filtering solution. A suitable treatment is for example one in which the molasses is clarified by the use of commercial calcium acid phosphate, ("super-phosphate") with or without the addition of a small amount of ammonia, the mixture being heated moderately. For example, a batch of 10,000 pounds of molasses may be diluted slightly, and, if desired, compounds of ammonia added thereto, the temperature raised to 60°–70° C., and about 1000 pounds of super-phosphate added, whereupon the mixture may be filtered through a suitable filter preferably with the accompanying use of "filter-cel" or the like. The resulting solution will have an acidity of about 5° or over (calculated as the number of cc. of normal soda necessary to neutralize 100 cc. thereof), and a concentration of about 15° to 20° Balling, such concentrations of the prepared nutrient solution will hereafter be referred to by the term "relatively concentrated".

A suitable portion of this prepared solution, for example up to about 15%, is run directly into the fermenter while the balance is pumped to a supply reservoir. Enough suitably tempered water is added to the fermenter to obtain a density of approximately 1°–2° Balling and a temperature of approximately 33° C., the acidity being adjusted if necessary to a suitable concentration such as, for example, 0.6°. A few minutes prior to the time at which the final dilution is reached, the seed yeast is added, preferably to an amount of from 20–27%, based on the sugar material (on the basis of 50% fermentable sugars) to be used during the first stage of propagation. The nutrient solution having been prepared and stocked, propagation is instituted with fairly high aeration, the temperature being slowly lowered until at about the end of the fourth hour it has reached about 30° C. and is thereafter maintained approximately constant, at least throughout any given stage of propagation.

During the period of propagation, the reserve nutrient solution is lowly and substantially continuously added in amounts such that the density is maintained substantially constant, such amounts being larger than those heretofore deemed practical and varying from hour to hour from approximately 2% up to 10%. Toward the end of and between each stage of the total period of propagation such "addition" is either largely diminished or entirely suspended in order to obtain a full utilization of the nutrient materials. For example, in a total fermentation time of 14 hours, no addition is made during the seventh hour or during the last hour and the rate of addition is considerably diminished during the sixth hour. Moreover, between the stages of the propagation period, for example, during the seventh hour while the "addition" has ceased, aeration is diminished and the yeast containing solution is withdrawn from the fermenter until for example about 10–70% of the quantity present at the end of the preceding hour remains, the withdrawal being regulated in accordance with the salt concentration of the liquid in the fermenter. The yeast containing solution thus withdrawn may be immediately separated and is desired a portion of the sepa-

rated yeast may be returned to the fermenter to act as seed yeast for the next succeeding stage or if desired the withdrawn solution may be used in a subsequent stage of propagation in a manner similar to the use of the residue in the fermenter. After such withdrawal sufficient water, both cold and hot, is added to the fermenter to maintain the temperature substantially constant, and again to bring the content of the fermenter up to approximately the initial volume of the diluted portion, whereupon "addition" and higher aeration are resumed.

When necessary either at the beginning of any stage of propagation or from hour to hour during the process, accompanying the additions from the storage reservoir, there is added to the fermenter supplemental nutrient materials adapted to regulate the acidity of the solution and to supply for example, yeast-assimilable nitrogen, preferably in the form of ammonium compounds. This may be accomplished by the selective addition of suitable ammonium compounds of an organic or inorganic nature, such as for example, aqua ammonia, ammonium carbonate, ammonium sulphate, ammonium phosphate, ammonium lactate and the like, it being desirable to maintain the acidity throughout the process approximately constant and to have present at the beginning of each stage of propagation a nitrogen concentration of approximately 0.06%, the concentration of the latter substance being allowed to fall gradually during each stage of the propagation in order to insure an efficient utilization thereof. For example, in the above described process there are added during each stage of the propagation a total of approximately 160 liters of aqua ammonia and 90 pounds of ammonium sulphate. Also regulated amounts of a suitable acid may be added if, and when necessary. In one aspect, therefore, the process may be considered as comprising the preparation of a yeast nutrient solution, the initiating of propagation of yeast with aeration in a diluted portion thereof, slowly and substantially continuously adding thereto yeast-nutrient materials to supply the deficiencies of the solution and including material to control the acidity, periodically concurrently diminishing or interrupting the addition of nutrients, lowering the aeration and withdrawing a portion of the yeast containing liquid, and thereafter diluting the residue thereof with suitably tempered water and then continuing the propagation with resumption of higher aeration and addition of nutrients.

By the use of the process, a total yield of yeast of approximately 85% and over (calculated on the basis of raw materials containing 50% fermentable sugars) may be obtained, such yeast having very desirable properties in that it presses well, is of a light color, and has good keeping qualities and excellent baking strength.

It will be observed that in carrying out the above process, a more efficient utilization of the apparatus is attained, in that at least double quantities of materials can be passed through a fermenter in a given time with a consequent saving in the amount of air and other ancillary materials and apparatus used for the propagation of yeast, while at the same time increasing the yield and quality of the yeast produced.

Since certain changes may be made in carrying out the above method without departing from the scope of the invention, it is intended that all matter contained in the above description shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

Having described our invention, what we claim as new and desire to secure by Letters Patent, is:

1. A process of manufacturing yeast by propagation with aeration, which comprises suspending seed yeast in a non-toxic liquid, aerating the liquid, adding yeast nutrients to the liquid in regulated amounts during the propagating period, periodically withdrawing a portion of the yeast containing liquid, diluting the residue thereof and then continuing the propagation therein with addition of nutrients.

2. A process of manufacturing yeast by propagation with aeration, which comprises suspending seed yeast in a non-toxic aqueous liquid, aerating the liquid, adding yeast nutrients to the liquid in regulated amounts during the propagating period, periodically concurrently diminishing the addition of nutrients, lowering the aeration, and withdrawing a portion of the yeast containing liquid and thereafter diluting the residue thereof and continuing the propagation therein with resumption of higher aeration and addition of nutrients.

3. A process of manufacturing yeast by propagation with aeration, which comprises suspending seed yeast in a non-toxic aqueous liquid, aerating the liquid, adding yeast nutrients to the liquid in regulated amounts during the propagating period, periodically withdrawing a portion of the yeast containing liquid, diluting the residue thereof and continuing the propagation therein with addition of nutrients, the temperature of the liquid in which the seed yeast is sus-

pended and the temperature maintained during the first few hours only of a period of propagation being above 30° C.

4. A process of manufacturing yeast by propagation with aeration, which comprises suspending seed yeast in a non-toxic aqueous liquid, aerating the liquid, adding yeast nutrients to the liquid in regulated amounts during the propagating period, periodically concurrently diminishing the addition of nutrients, lowering the aeration, and withdrawing a portion of the yeast containing liquid, and thereafter diluting the residue thereof and continuing the propagation therein with resumption of higher aeration and addition of nutrients, the temperature of the liquid in which the seed yeast is suspended and the temperature maintained during a portion of the period of propagation being above 30° C.

5. A process of manufacturing yeast, which comprises starting propagation with a suspension of seed yeast in a fermenter partially filled with a non-toxic aqueous liquid, aerating the liquid, adding yeast nutrients to the liquid in regulated amounts, during the propagating period, periodically withdrawing a portion of the yeast containing liquid, diluting the residue thereof to approximately the volume of the liquid initially in the fermenter and then continuing the propagation therein with the accompanying addition of yeast nutrients.

6. A process of manufacturing yeast, which comprises starting propagation with a suspension of seed yeast in a fermenter partially filled with a dilute nutrient solution, aerating the solution, adding yeast nutrients to the solution in regulated amounts during the propagating period and periodically restoring the starting conditions in the fermenter by withdrawing a portion of the yeast containing liquid and diluting the remainder thereof.

7. A process of manufacturing yeast, which comprises starting propagation with a suspension of seed yeast in a fermenter partially filled with a dilute nutrient solution, aerating the solution, adding yeast nutrients to the solution in regulated amounts during the propagating period, periodically concurrently diminishing the addition of nutrients, lowering the aeration and withdrawing a portion of the yeast containing liquid, and thereafter approximately restoring the starting conditions in the fermenter by diluting the remainder of the yeast containing liquid with water and continuing the propagation therein with increased aeration and addition of nutrients.

8. A process of manufacturing yeast, which comprises starting propagation with a suspension of seed yeast in a fermenter partially filled with a dilute nutrient solution, aerating the solution, adding yeast nutrients to the solution in regulated amounts during the propagating period and periodically restoring certain of the starting conditions in the fermenter by withdrawing a portion of the yeast containing liquid and diluting the remainder thereof, the temperature of the liquid in which the seed yeast is suspended and the temperature maintained during the first few hours only of the period of propagation being in the neighborhood of 38 ° C.

9. A process of manufacturing yeast, which comprises starting propagation with a suspension of seed yeast in a fermenter partially filled with a dilute nutrient solution, aerating the solution, adding yeast nutrients to the solution in regulated amounts during the propagating period, the temperature of the nutrient solution in the fermenter being maintained for the first few hours only above 30° C., periodically concurrently diminishing the addition of nutrients, lowering the aeration and withdrawing a portion of the yeast containing liquid, and thereafter approximately restoring certain of the starting conditions in the fermenter by diluting the remainder of the yeast containing liquid with water and continuing the propagation therein with increased aeration and addition of nutrients.

10. A process of manufacturing yeast, which comprises preparing a relatively concentrated yeast nutrient solution, initiating propagation of yeast in a fermenter containing a diluted portion of the nutrient solution, aerating the solution, adding the remainder of the concentrated solution to the diluted portion in regulated amounts during the period of propagation, periodically withdrawing a portion of the yeast containing liquid, diluting the residue thereof and then continuing the propagation with the addition of nutrients.

11. A process of manufacturing yeast, which comprises preparing a relatively concentrated yeast nutrient solution, initiating propagation of yeast in a fermenter containing a diluted portion of the nutrient solution, aerating the solution, adding the remainder of the concentrated solution to the diluted portion in regulated amounts during the propagation period, periodically concurrently diminishing the addition of the concentrated solution, lowering the aeration, and withdrawing a portion of the yeast containing liquid, and thereafter diluting the residue thereof and continuing the propagation therein with increased aeration and addition of the concentrated nutrient solution.

12. A process of manufacturing yeast, which comprises preparing a relatively concentrated yeast nutrient solution, initiating propagation of yeast in a fermenter containing a diluted portion of the nutrient solution, aerating the solution, adding to the solution during the period of propagation and in

regulated amounts, yeast nutrients including the remainder of the concentrated solution, periodically concurrently diminishing the addition of nutrients, lowering the aeration, and withdrawing a portion of the yeast containing liquid, and thereafter diluting the residue thereof and continuing the propagation therein with resumption of higher aeration and addition of nutrients.

13. A process of manufacturing yeast, which comprises preparing a yeast nutrient solution including substantial amounts of sugar material and yeast-nutrient salts, initiating propagation of yeast in a fermenter containing a diluted portion of the nutrient solution, aerating the solution, adding to the diluted solution during the period of propagation and in regulated amounts the remainder of the concentrated solution together with other yeast nutrients, periodically withdrawing a portion of yeast containing liquid, diluting the residue thereof and then continuing the propagation therein with increased aeration and addition of nutrients.

14. A process of manufacturing yeast, which comprises preparing a yeast-nutrient solution including substantial amounts of sugar material and yeast nutrient salts, initiating propagation of yeast in a fermenter containing a diluted portion of the nutrient solution, aerating the solution, adding to the diluted solution during the period of propagation and in regulated amounts the remainder of the concentrated solution together with other yeast nutrients including an antacid substance, periodically withdrawing a portion of the yeast containing liquid, diluting the residue thereof and then continuing the propagation therein of increased aeration and addition of nutrients.

15. A process of manufacturing yeast, which comprises preparing a yeast nutrient solution including substantial amounts of sugar material and yeast-nutrient salts, initiating propagation of yeast in a fermenter containing a diluted portion of the nutrient solution, aerating the solution, adding to the diluted solution during the period of propagation and in regulated amounts the remainder of the concentrated solution together with other yeast nutrients including an antacid substance, periodically withdrawing a portion of the yeast containing liquid, diluting the residue thereof and then continuing the propagation therein with increased aeration and addition of nutrients, the temperature of the diluted nutrient solution in which the propagation is initiated and the temperature maintained during the first few hours only of a period of propagation being above 30° C.

16. A process of manufacturing yeast, which comprises preparing a yeast nutrient solution including substantial amounts of sugar material and yeast-nutrient inorganic salts, initiating propagation of yeast in a fermenter containing a diluted portion of the nutrient solution, aerating the solution, adding to the diluted solution during the period of propagation and in regulated amounts the remainder of the concentrated solution together with other yeast nutrients including an antacid substance, periodically concurrently diminishing the addition of nutrients, lowering the aeration and withdrawing a portion of the yeast containing liquid, and thereafter diluting the residue thereof and continuing the propagation therein with increased aeration and addition of nutrients.

17. A process of manufacturing yeast, which comprises preparing a yeast nutrient solution including substantial amounts of molasses and yeast-nutrient inorganic salts, initiating propagation of yeast in a fermenter containing a diluted portion of the nutrient solution, aerating the solution, adding to the diluted solution during the period of propagation and in regulated amounts the remainder of the concentrated solution together with other yeast nutrients including an antacid substance, periodically withdrawing a portion of the yeast containing liquid, diluting the residue thereof and then continuing the propagation therein with increased aeration and addition of nutrients.

18. A process of manufacturing yeast, which comprises preparing a yeast nutrient solution including substantial amounts of molasses and yeast-nutrient inorganic salts, initiating propagation of yeast in a fermenter containing a diluted portion of the nutrient solution, aerating the solution, adding to the diluted solution during the period of propagation and in regulated amounts the remainder of the concentrated solution together with other yeast nutrients including an antacid substance containing yeast-assimilable nitrogen, periodically withdrawing a portion of the yeast containing liquid, diluting the residue thereof and then continuing the propagation therein with increased aeration and addition of nutrients.

19. A process of manufacturing yeast, which comprises preparing a yeast nutrient solution including substantial amounts of molasses and yeast-nutrient inorganic salts, initiating propagation of yeast in a fermenter containing a diluted portion of the nutrient solution, aerating the solution, adding to the diluted solution during the period of propagation and in regulated amounts the remainder of the concentrated solution together with other yeast nutrients including an antacid substance, periodically withdrawing a portion of the yeast containing liquid, diluting the residue thereof and then continuing the propagation therein with increased aeration and addition of nutrients, the temperature of the diluted nu-

trient solution in which the propagation is initiated and the temperature maintained during the first few hours only of a period of propagation being above 30° C.

20. A process of manufacturing yeast, which comprises preparing a yeast nutrient solution including substantial amounts of molasses and yeast-nutrient inorganic salts, initiating propagation of yeast in a fermenter containing a diluted portion of the nutrient solution, aerating the solution, adding to the diluted solution during the period of propagation and in regulated amounts the remainder of the concentrated solution together with other yeast nutrients including an antacid substance containing yeast-assimilable nitrogen, periodically withdrawing a portion of the yeast containing liquid, diluting the residue thereof and then continuing the propagation therein with increased aeration and addition of nutrients, the temperature of the diluted nutrient solution in which the propagation is initiated and the temperature maintained during the first few hours only of a period of propagation being above 30° C.

21. An improved method of carrying on a continuous-addition process of manufacturing yeast by propagation with aeration, which includes periodically interrupting the addition of yeast nutrients, withdrawing a portion of the yeast containing solution, diluting the residue thereof and then continuing the propagation therein with the addition of yeast nutrients.

22. An improved method of carrying on a continuous-addition process of manufacturing yeast by propagation with aeration over a period of at least eight hours, which includes initiating propagation of yeast at a temperature above 30° C., and during the first few hours of the propagation allowing the temperature to fall to below 30° C.

23. An improved method of carrying on a continuous-addition process of manufacturing yeast by propagation with aeration, which includes periodically interrupting the addition of yeast nutrients, withdrawing a portion of the yeast containing liquid, diluting the residue thereof with water and then continuing the propagation therein, the temperature of the yeast containing solution during the first few hours only of at least one of the periodic stages being above 30° C.

24. An improved method of carrying on a continuous-addition process of manufacturing yeast by propagation with aeration, which includes the steps of periodically concurrently diminishing the addition of yeast nutrients, lowering the aeration and withdrawing a portion of the yeast containing liquid, and thereafter diluting the residue thereof and continuing the propagation therein with increased aeration and addition of yeast nutrients.

25. An improved method of carrying on a continuous-addition process of manufacturing yeast by propagation with aeration, which includes the steps of periodically concurrently diminishing the addition of yeast nutrients, lowering the aeration and withdrawing a portion of the yeast containing liquid, and thereafter diluting the residue thereof, and continuing the propagation therein with increased aeration and addition of nutrients, the temperature of the yeast containing solution during the first few hours only of at least one of the periodic stages being above 30° C.

26. A process of manufacturing yeast by propagation with aeration, which comprises suspending seed yeast in a non-toxic liquid, aerating the liquid, adding yeast nutrients to the liquid in regulated amounts during the propagating period, periodically concurrently diminishing the addition of nutrients, lowering the aeration and withdrawing a portion of the yeast containing liquid, and thereafter diluting the residue thereof, removing yeast from the withdrawn yeast-containing liquid, returning a portion of such yeast to the diluted residue and continuing the propagation therein with increased aeration and addition of nutrients.

27. A process of manufacturing yeast by propagation with aeration, which comprises suspending seed yeast in a non-toxic aqueous liquid, aerating the liquid, adding yeast nutrients to the liquid in regulated amounts during the propagating period, periodically concurrently diminishing the addition of nutrients, lowering the aeration and withdrawing a portion of the yeast containing liquid, and thereafter diluting the residue thereof, continuing the propagation therein with increased aeration and addition of nutrients, and during the period of propagation neutralizing the deleterious excess of acidity by the controlled addition of a suitable antacid substance.

28. An improved method of carrying on a continuous-addition process of manufacturing yeast by propagation with aeration over a period of about eight hours, which includes initiating the propagation of yeast with aeration in a small portion of dilute nutrient solution at a temperature in the neighborhood of 33° C., gradually adding a yeast-nutrient solution thereto, and after a few hours slowly lowering the temperature to below 30° C.

29. An improved method of carrying on a continuous-addition process of manufacturing yeast by propagation with aeration over a period of about eight hours, which includes initiating the propagation of yeast with aeration in a small portion of dilute nutrient solution at a temperature in the neighborhood of 33° C., gradually adding a yeast-nutrient solution thereto, and after a

few hours gradually lowering the temperature to below 30° C. and holding it there for the remainder of the propagating period

30. An improved method of carrying on a continuous-addition process of manufacturing yeast by propagation with aeration over a period of about eight hours, which includes preparing a yeast-nutrient solution including molasses as a sugar material, initiating the propagation of yeast with aeration in a small portion of the nutrient solution, diluted with water and at a temperature in the neighborhood of 33° C., gradually adding the prepared nutrient solution during the eight-hour period, and a few hours after the initiation of the propagation gradually lowering the temperature to below 30° C.

In testimony whereof we affix our signatures.

ROBERT L. CORBY.
WILHELM H. F. BÜHRIG

PLAINTIFF'S EXHIBIT P-6.

Certified Copy of File Wrapper and Contents of United States Patent No. 1,449,103 to Friedrich Hayduck, Assignor to The Fleischmann Company, Dated March 20, 1923.

(Physical Exhibit.)

PLAINTIFF'S EXHIBIT P-7.

Certified Copy of File Wrapper and Contents of United States Patent No. 1,449,105 to Friedrich Hayduck, Assignor to The Fleischmann Company, Dated March 20, 1923.

(Physical Exhibit.)

PLAINTIFF'S EXHIBIT NO. 8.

Certified Copy of File Wrapper and Contents of United States Patent No. 1,449,106 to Friedrich Hayduck, Assignor to The Fleischmann Company, Dated March 20, 1923.

(Physical Exhibit.)

PLAINTIFF'S EXHIBIT P-9.

Certified Copy of File Wrapper and Contents of United States Patent No. 1,449,109 to Friedrich Hayduck, Assignor to The Fleischmann Company, Dated March 20, 1923.

(Physical Exhibit.)

PLAINTIFF'S EXHIBIT P-10.

Certified Copy of File Wrapper and Contents of United States Patent No. 1,673,735 to Robert L. Corby and Wilhelm H. F. Buhrig, Assignor to The Fleischmann Company, Dated June 12, 1928.

(Physical Exhibit.)

PLAINTIFF'S EXHIBIT P-11.

UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF NEW JERSEY

STANDARD BRANDS INCORPORATED, Plaintiff, —VS— NATIONAL GRAIN YEAST CORPORATION, Defendant.	In Equity No. E-4552 On United States Letters Patent Nos. 1,449,103, 1,449,105, 1,449,106, 1,449,109, and 1,673,735

CONSOLIDATION OF PLAINTIFF'S INTERROGATORIES AND DEFENDANT'S ANSWERS.

Interrogatory I(a). Has the defendant, within six years prior to December 30, 1932, practiced a process of manufacturing bakers' yeast with aeration using molasses as all or part of the sugar material?

Answer: Yes.

Int. I(b). In such process what sugar material (if any) other than molasses was used, and in what proportion to the total sugar material was the molasses?

Answer: Extractives of saccharified malt and other starch-bearing materials subject to saccharification in varying proportions depending upon the quality of the malt, the amount of available nutrient which can be utilized by the yeast, the price and composition of the raw materials and the judgment of the operator. The amount of molasses has varied between 85% and 90% of the total sugar material.

Int. I(c). If the answer to Interrogatory I(a) is in the affirmative, has defendant used ammonium phosphate in said process?

Answer: Yes, as a source of phosphorus in accordance with the common practices and teachings of the prior art.

Int. I(d). If the answer to Interrogatory I(a) is in the affirmative, has defendant used ammonium sulphate in said process?

Answer: Yes, as a source of nitrogen in accordance with the common practices and teachings of the prior art.

Int. I(e). If the answer to Interrogatory I(a) is in the affirmative, has defendant added a neutralizing agent to the fermenting liquid during the yeast propagation period?

Answer: Yes, at times—no, at other times, depending upon the variables given in answer to I(b).

Int. I(f). If the answer to Interrogatory I(e) is in the affirmative, has defendant added aqua ammonia to the fermenting liquid during the yeast propagation period?

Answer: Not as regular practice, only infrequently in emergencies caused by variations in raw materials which produce variations in the fermenting liquid.

Int. I(h). If the answer to Interrogatory I(e) is in the affirmative, has defendant added di-ammonium phosphate to the fermenting liquid during the yeast propagation period?

Answer: Defendant has added di-ammonium phosphate to the fermenting liquid during the yeast propagation period.

Int. I(i). In case the defendant has answered affirmatively any of the Interrogatories numbered I(a) to I(h) inclusive, which of the steps so admitted were used in the same run of yeast manufactured at any time during the term stated?

Answer: Defendant has used at times in the same run I(a), I(b), I(c), I(d), I(h) and I(e) at times as stated in answers I(b) and I(e).

Int. II. If the answer to Interrogatory I(e) is in the affirmative, then as to such process state the range of acidity maintained, and the range of acidity desired, during each hourly period of the propagation process.

Answer: The degree of acidity is and was maintained below the point of absolute toxicity. The acidity was measured by any of the well-known methods and with a knowledge of the degree or point of toxicity dependent upon the kind of acid used or released from an ammonium compound during fermentation. The degree of toxicity varies hourly depending upon the culture and the kinds of acid, and the concentration of the wort because the more concentrated the wort the greater the buffering action.

Int. III. Has the defendant, within six years prior to December 30, 1932, practiced a process of manufacturing bakers' yeast by initiating the propagation of yeast with aeration in a dilute yeast-nutrient solution (such as about 2° Balling or less), and, during a continuing period of further propagation, adding thereto further quantities of yeast-nutrients in solution?

Answer: Yes, within the Balling range of the prior art and the procedure of the additions of the prior art.

Int. IV. If the answer to Interrogatory III is in the affirmative, has the defendant prepared a yeast-nutrient solution and initiated such propagation in a dilute portion thereof, and during a period of further propagation added thereto a more concentrated nutrient solution (such as the remainder of the prepared yeast-nutrient solution)?

Answer: Yes, in accordance with the prior art.

Int. V. If the answer to Interrogatories III and IV, or either of them, is in the affirmative, did the dilute

nutrient solution, in which the propagation was initiated, contain some quantity of all essential yeast-nutrients?

Answer: Yes, in accordance with the prior art.

Int. VI. If the answer to either Interrogatory III or IV is in the affirmative, state what yeast-nutrients were added and when, how, and in what amounts such additions were made.

Answer: Yeast nutrients such as are available from molasses, barley malt, malt sprouts and ammonium compounds which yield nitrogen and phosphorus and other mineral nutrients essential to yeast growth, were used at such times and in such amounts as are necessary to sustain yeast growth.

Int. VII. Has the defendant within six years prior to December 30, 1932, practiced a process of manufacturing bakers' yeast in which the propagation of yeast was initiated in a dilute nutrient solution containing an ammonium salt of an inorganic acid, aerating the solution and adding thereto, during the propagation period, yeast-nutrient materials including a substance having an alkaline reaction and containing yeast-assimilable nitrogen?

Answer: Yes, according to the prior art.

Int. X. If the answer to the foregoing Interrogatories or any of them is in the affirmative, then as to each so affirmed, the defendant shall furnish the plaintiff with mash records and informative descriptions of two runs typifying such process, giving complete data as follows:

(a) The steps, materials and amounts thereof used in the mashing operations and in the preparation of the nutrient solution and during the propagation.

(b) The time of each operation.

(c) The temperatures, densities, acidities (including a description of the scale of acidity and the method

of determining the same) of each solution used and of the propagating liquid at hourly or half-hourly periods during the manufacture.

(d) The amount of seed yeast used.

(e) The yield of yeast obtained (stating the moisture content).

(f) The weight of each of the raw materials used.

(g) Typical samples of each of the raw materials used in the preparation of the nutrient solution, sufficient in quantity for analysis by plaintiff.

(h) The concentration and total volume of the extract and wash waters obtained from mashing the cereal materials.

(i) The Balling of the original molasses, if such be used.

(j) The method, if any, of the treatment of molasses prior to use for yeast propagation.

(k) The Balling and volume of the solution obtained from the molasses.

(l) The concentration and volume of the liquid initially in the fermenter at the beginning of the propagating period.

(m) The total volume of liquid at the end of the propagating period, together with a statement of how much, if any, has been added or withdrawn during such period.

(n) The amounts of nutrient material added during the propagating period, and the times and amounts of each such addition and, if solid, whether in water solution.

(o) The amounts of any liquid withdrawn during the propagating period, and full information as to what was done therewith.

(p) The Balling of the propagating liquid from hour to hour, including the final Balling of the yeast-containing solution at the end of the propagating period.

(q) The amount of total nitrogen, ammonia nitrogen, and alcohol, left in the beer after the yeast has been separated therefrom.

(r) An analysis typical of the seed yeast and final yeast product.

(s) The amount of aeration used.

Answer: Defendant's process involves a prolonged lactic acid souring of a combined grain and molasses mash which supplies a large amount of natural organic nitrogen liberated from the basic materials as a result of excessive protein hydrolysis. There also results the formation of a large amount of lactic acid, a desirable natural organic acid, which is combined as it is formed, with aqua ammonia to form ammonium lactate, which accumulates in the mash. Ammonium acid phosphate and di-ammonium phosphate are employed to supply the needed phosphorous and ammonium sulfate is added to supply additional nitrogen in a form to maintain a favorable acidity of the wort. Occasionally additions of mineral acid are required for this purpose.

Records of a typical run at about the time the suit was filed are attached.

Basic materials:—

Beet molasses	23,000 pounds
Malt	3,600 pounds
Malt sprouts	3,900 pounds

GRAIN MASH:

The ground malt and malt sprouts are mixed with cold water in the mash tank and are mashed by the

usual well known method, for peptonization of the proteins and conversion of the starch.

Peptonization is accomplished by gradually heating the mixture to 134° F. and holding at this temperature for one-half hour. Next the mash is heated to 146° F. and held at this temperature for about two hours or until all the starch has been converted into sugar. Next the mash is cooled to 128° F. and stocked with a pure culture of Lactobacillus Delbrucki. This grain mash (total volume 6,500 gallons) is allowed to sour for twenty-four hours and during this time a total of 204 pounds of acqua ammonia is added to the mash in six portions to combine with the lactic acid as it is being formed.

Molasses Mash:

In the meantime, the molasses is being prepared in a separate tank. The 23,000 pounds of molasses (approximately 2000 gallons) is diluted with 3000 gallons of water and acidified with 144 pounds of sulphuric acid. The mixture is heated with steam and during the heating process, there is added 96 pounds of monocalcium phosphate. Heating is continued to the boiling point and then the whole mixture is allowed to stand over night.

Grain and Molasses Mixed:

The molasses mash which has been standing over night is now decanted off and pumped to the souring tank on top of the grain mash. More aqua ammonia is added from time to time to combine with the lactic acid as formed, until a total of from 350 to 400 pounds of ammonia has been added during the two days of souring. Next the mash is sterilized by heating with steam to 160° F. On the morning of the third day the sterile mash is pumped to the filter tub where the liquid extract is separated from the insoluble grain residues.

The filtered mash is used for making both seed yeast and commercial yeast and is divided into two parts, between one-fifth and one-sixth being used for the seed.

The portion for seed yeast is taken from the first run heavy extract, coming from the filter tub and is set aside in a separate tank. This is used for making one large fermenter of Seed Yeast.

Of the balance of the mash to be used for commercial yeast a sufficient part is set aside in another separate tank, for setting the commercial fermenters.

The balance of the wort or extract is pumped into a large wooden storage tank of 16,500 gallons' capacity. The insoluble grains in the filter tub are repeatedly sparged with hot water in order to wash out all soluble extract and * these spargings are used to dilute the wort to be added to the fermenters during yeast propagation. The dilute extract or spargings are added until the tank is full. This gives approximately 16,500 gallons of feed wort of approximately 12% Balling gravity.

The feed wort is well agitated with air to secure a mixture of uniform gravity and 257 pounds of ammonium sulphate are added to supply additional nitrogen as yeast nutrient. The balance of the inorganic salts used, including 250 pounds ammonium sulphate, 100 pounds mono-ammonium phosphate, and 350 pounds di-ammonium phosphate are added directly to the fermenters during propagation to supply nitrogen and phosphate as required by the yeast growth.

Four wooden fermenters of approximately 15,000 gallons' capacity, and two metal fermenters of approximately double that capacity are employed for the portion of the above described mash used for producing

*Note: Counsel agree that this should read "a part of these" spargings.

the commercial yeast. The four wooden fermenters are "set" by charging them with about approximately 9600 gallons of dilute wort solution made up chiefly of spargings used in washing the mash in the filter tub after the concentrated wort has been drawn off. The deficiency, if any, is made up by concentrated wort from the storage tank, and water. The concentration of the initial solution after seeding is approximately 1.3 Balling.

Each fermenter is seeded with a seed yeast solution of approximately 750 pounds and 20 pounds of ammonium sulphate, and 50 pounds mono-ammonium phosphate are added at the start.

After about one hour the feed of the concentrated wort from the storage tank is started from three feed cocks at the rate of 75 gallons each per hour. The temperature is maintained throughout as near as possible at 28° C. After two hours the feed is increased to four feed cocks and after a further two hours to five feed cocks and continued for two hours and fifteen minutes.

At hourly intervals the wort is tested for concentration and acidity. The method employed for testing the acidity is the standard neutralization test carried out by taking 40 cc. of sample and titrating with one-tenth normal sodium hydroxide solution, using litmus paper as indicator. Occasionally, but not as regular practice, the acidity is determined by measuring the hydrogen ion concentration.

At approximately one and a half or two hour intervals di-ammonium phosphate and ammonium sulphate are added to the wort in varying quantities in the order of eight to twenty pounds to supply the needed nitrogen and phosphate.

After seven and one-half hours water is added to bring the total volume up to about 13,000 gallons and

one-half of the total solution in two of the wooden fermenters discharged into one of the iron fermenters.

The fermentation is then continued in all the fermenters to which the concentrated wort is fed and diammonium phosphate and ammonium sulphate are added as indicated on the attached "Process Tables" dated December 9, 1932.

From the fermenters the wort is delivered to the centrifugal separators.

The attached process tables dated April 27, 1931 show a typical run of a somewhat modified process as employed by the defendant during the year 1931. The mash was prepared according to the same procedure described above, with certain differences in the relative proportions of the ingredients, as indicated. A portion of the mash was set aside for use in the seed fermenters and the balance after setting the fermenters was used as the feed wort.*

All the aqua ammonia was added to the feed wort to form ammonium lactate and all the ammonium phosphate and ammonium sulphate (320 pounds mono-ammonium phosphate and 162 pounds sulphate) was added directly to the fermenters, the **balance of ammonium sulphate being used in the seed fermenters.

In the process of which the April 27 records are typical, all the ammonium phosphate is added initially to the fermenter while the ammonium sulphate was added in part initially and with later small additions, as indicated on the tables. Also, as indicated, the acidity toward the end of the fermentation period was raised by the addition of one or two liters of acid. Dur-

*Note: Counsel agree that this sentence is incorrect in that no seed yeast was made from this mash and all of the mash materials were used in making the commercial yeast.

**Note: See preceding Footnote. Counsel agree that the balance of the ammonium sulphate 190 lbs. was added to the reserve wort, 50 lbs to that in the SCT tank, 100 lbs. to the LCT tank and 40 lbs. to the IP tank.

ing the operation of this process complete fermentation takes place in a single tank.

The foregoing, together with the mash records, contains all the information asked for under Interrogatory X except the following:

X(d). The amount of seed yeast varies between 9% and 12% of pressed yeast (70% moisture) on the weight of the raw materials.

X(e). The yield of yeast varies between 60% and 70% pressed yeast (70% moisture) on the weight of the raw materials.

X(g). Defendant has not in its possession now samples of any of the raw materials used by it prior to the filing of the Bill of Complaint herein. The materials used by defendant are standard commodities purchased in the open market. Defendant will on request furnish plaintiff with samples of materials which it is now using and which it believes to be of the same character as used before the Bill of Complaint was filed, except for the unavoidable variations in organic materials, particularly molasses.

X(i). Defendant has no figures as to the Balling of the original molasses.

X(k). The defendant has no figures except as given above of the Balling and volume of the solution obtained from the molasses.

X(q). Defendant has made no analysis of the beer after the yeast is separated therefrom. Defendant made no analysis of the seed yeast or the final yeast product except for protein content which averages over 50%.

X(s). Defendant has made no accurate measure of the amount of aeration used, but it is roughly from

800 to 1200 cubic feet per minute per 15,000 gallon fermenter.

(NOTE: On the Mash Records:

A indicates mono ammonium phosphate
B indicates aqua ammonia
C indicates ammonium sulphate
D indicates di-ammonium phosphate
C.P. indicates calcium phosphate)

PLAINTIFF'S EXHIBIT P-12.

UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF NEW JERSEY

STANDARD BRANDS INCORPORATED, Plaintiff, —VS— NATIONAL GRAIN YEAST CORPORATION, Defendant.	In Equity No. E-4552 On United States Letters Patent Nos. 1,449,103, 1,449,105, 1,449,106, 1,449,109, and 1,673,735

SUPPLEMENTAL FACTS OF DEFENDANT'S OPERATIONS GIVEN BY DEFENDANT'S COUNSEL.

In addition to the information given by defendant in its answers to plaintiff's interrogatories as to flow sheets M177-M180, dated April 27, 1931, and flow sheets 3539-3544, dated December 9, 1932, defendant's counsel has supplied plaintiff's counsel with a mash sheet of September 12, 1931 and flow sheets therefor Nos. M559-M561, dated September 15, 1931, together with the following supplemental information relating to the aforesaid processes.

1. As to Mash and Flow Sheets M 177-M 180

(a) The figure 467 represents the amount of ammonia left in the drum from the preceding mash, and out of which the ammonia for the mash in question is deducted. It is merely an inventory figure.

(b) "18T" indicates 18 pounds of ammonium phosphate used in after treatment of yeast.

(c) "S. C. T." indicates small copper tank; "L.C.T." indicates large copper tank; "I.P." indicates iron pre-fermenter.

(d) "65" indicates 65 pounds of calcium phosphate.

(e) The figures circled indicate the number of cocks open on the feed wort line at the times indicated on the sheet.

(f) The word "Separating" indicates the appearance of the yeast, that is, that it had begun to show a flocculent appearance.

(g) The volume of reserve solution in "S.C.T." was 2,500 gallons, in "L.C.T." 5,000 gallons and in "I.P." 2,000 gallons, which were fed successively into the fermenters. The total volume of the solution initially in the fermenters was 37,000 gallons and at the end the total volume was 46,500 gallons.

2. Mash and Flow Sheets 3539-3544

(a) These figures indicate that the total 3900 pounds of malt sprouts was mashed in two separate portions of 1500 and 2400, respectively.

(b) The figure "5" indicates five inches of molasses, one inch being equal to 512 pounds, "4L" indicates four liters of sulphuric acid, "6#" indicates six pounds calcium phosphate.

(c) The notation indicates 2500 gallons of feed wort put in the small copper tank for seed yeast.

(d) There are no arrows on Flow Sheet 3539. There appear to be some on 3542 and 3544. Wher-

ever these arrows appear they indicate changes that were made after the sheet was written up. The sheets are prepared in advance of the run as instructions to the foreman in charge. The changes were made after the original write-up and they are indicated by arrows appearing on these sheets.

(e) "2 Pails" indicates two pails of ammonium sulfate solution added to the seed yeast. The solution is of the strength of 60 pounds ammonium sulfate in 50 gallons of solution.

3. As to the Mash Sheets and Flow Sheets M 559-M 561

The total volume of the solution initially in the commercial fermenters was 28,000 gallons and the final volume was 35,000 gallons.

4. In all the processes typified by the above mentioned mash sheets, defendant has not analysed the spent wort for alcohol, has not recovered any alcohol.

Counsel for Defendant agrees that the above Supplemental Facts are correct.

PLAINTIFF'S EXHIBIT P-13.

Original Copy of Defendant's Mash Sheet of September 12 to 15, 1931.

Mash Saturday Sept 12th
For Tuesday Sept 15th
2 - 2nd Gen Seed + 3 conc 7's (wood)

Materials

Malt - 2600#
Sprouts - 3000#
Molasses - 16,700#

{ 2580# in mash tub
{ 500# in sour tank

Molasses Mash in New Tank

{ 32" Molasses
{ 26 L-acid
{ 80# Ca-Phosphate

Distribution of Materials

42% for Seed (2-Iron 7's) 58% for Conc (3 wood 7's)

140 - AP - 225+107 = 741
230 - Am - 240
224 - A.S - 258
34 - C.P - 46

Feed Wort - SCT - 17% B for Seed
L.C.T - 20% for Seed 80% for Conc
I.P. - 12% B - all for Conc. Yeast

Run to Sour tank - Monday morning

Sour Mash

11 P.M. - 11 - cc
2 A.M. - 23 - cc
6 A.M. - 34 - cc

11 P.M. - 28 - cc
6 A.M. - 28 cc

For Tuesday morning Heat to 170°F

Type new 9/15/31

NATIONAL GRAIN YEAST CORPORATION

Seed 138

Manufacturing Process—Table

Mash No. 26 A 1st 7 Date Sept 15, 1931

RAW MATERIALS

Malt 1075 lbs.
Sprouts 1250 lbs.
Corn lbs.
lbs.
Molasses 7000 lbs.
lbs.
Am. Phosphate 140 100 lbs. + 40
230 Ammonia 56 lbs.
224 Am. Sulphate 428 368 lbs. + 40
C.P. 35 lbs.

L.C.T 20% for Seed

S.C.T. For Seed + (20 from L.C.T.)

Acid Added
For Neutralization
During Fermentation
In Liquid Yeast

Am 741 − 254 = 487

Total Materials (B) 40 + 16 lbs.

Molasses
Total gallons molasses and water
Sterilizing Temperature
Sterilizing Time 17.0% B From M. to M.
Time start running in fermenter
Gravity of first extract
Acidity of first extract
Gallons in Fermenter

SCT {17.1 / 22 } 20

Grain Mash
Start Filtering 7.45 A. M.
Finish Filtering 3.20 P. M.
From M. to M.

Stocked with 5% 448# Lbs. of No. 138 Seed 1st Gen

Yield of Yeast, Net lbs. % Yield

Fermenting strength of yeast

Set at 2.5 Process of Fermentation (A) (C)

	TIME Hours	% BALLG.	°C	ACIDITY			
1	1.00	2.50	27	2.8	50	100 AIR	Feed
2	2	2.25	27	3.1			
3	3	1.90	27.5	4.0			
4	4	1.55	27	4.5		2 Pails	2.30 (2)
5	5	1.35	26.5	4.8		3 "	
6	6	1.45	27	3.5		3 "	6.00 (3)
7	7	1.60	27	2.8	2.5	3 "	
8	8	1.70	27	3.0	1.5	4 "	9.00 (4)
9	9	1.85	27.5	3.0		3 "	
10	10	2.05	27	3.2		3 "	10.30 (2)
11	11	2.1	27	3.0			
12	12	2.3	27	3.5		18.4	11.30 finish
13	1	2.4	27	4.0			

Blower 6.00 more air

~~20~~ changed 24

~~Put~~ 2 Liters Acid in wash tank
2nd Gen Seed - Use #2 tank
Clean Everything Good
For Seed

Time run to separators, From 1.00 M. to 2.15 M. No. of separators

Name

Iron Fermenter No. I

NATIONAL GRAIN YEAST CORPORATION

Seed 138

Manufacturing Process—Table

Mash No. 20-A 2nd F

Date Sept 15, 1931

RAW MATERIALS

Malt _____ lbs.
Sprouts _____ lbs.
Corn _____ lbs.
_____ lbs.
Molasses _____ lbs.
_____ lbs.
Am. Phosphate _____ lbs.
Ammonia _____ lbs.
Am. Sulphate _____ lbs.
_____ lbs.

Acid Added
For Neutralization _____
During Fermentation _____
In Liquid Yeast _____

Total Materials _____ lbs.

	Molasses			Grain Marsh		
Total gallons molasses and water				Start Filtering		
Sterilizing Temperature				Finish Filtering		
Sterilizing Time	From	M. to	M.	From	M. to	M.
Time start running in fermenter						
Gravity of first extract						
Acidity of first extract						
Gallons in Fermenter						

Stocked with 5/4" = 448 Lbs. of No. 138 Seed 1st gen

Yield of Yeast, Net _____ lbs. _____ % Yield

Fermenting strength of yeast _____

Process of Fermentation

	TIME Hours	% BALLG.	°C	ACIDITY	(A)	(C)	Feed
2 15		2.5 2.50	27	2.8	50 ✓	100 ✓	
1	3	2.20	27	3.2			
2	4	1.85	27	3.7			4 00 (2)
3	5	1.50	27	4.1		2 Pails	
4	6	1.45	27	4.3		3 ✓ "	7 30 (3)
5	7	1.50	27	3.6		3 ✓ "	
6	8	1.60	27	3.0	.2. L. ac.	3 ✓ "	10 30 (4)
7	9	1.80	27	2.8	.1. L.	4 ✓ "	
8	10	1.95	27	3.4		3 ✓	12 00 (2)
9	11	2.0	27	2.8		3 ✓	
10	12	2.15	27	3.3			12 45 finish
11	1	2.3	27	4.3		184	
12	2 15	2.4	27.5	5.0		✓	
13							
14							
15							24 new rate
16							
17							
18							
19							
20							

Time run to separators, From 2 15 M. to 3 30 M. No. of separators _____

Name _____

Iron Fermenter No. 2

NATIONAL GRAIN YEAST CORPORATION

Mash No. M-559 Manufacturing Process—Table Date Sept 15, 1931

RAW MATERIALS

Malt	1525 lbs.	Acid Added	114 a 94%
Sprouts	1750 lbs.	For Neutralization	
Corn	lbs.	During Fermentation	
	lbs.	In Liquid Yeast	
Molasses	9700 lbs.		
	lbs.		
Am. Phosphate	225 + 10T lbs.		
240 Ammonia	94 + 19 lbs.		
258 Am. Sulphate	333 193 lbs.		
Cu. P.	45 lbs.		

$\frac{LCT}{80 + (20 \text{ Acid})} + \frac{IP}{40}$ = 120 # infect for Conc.

100 #

Total Materials 64 + 38 lbs.

	Molasses	Grain Mash
Total gallons molasses and water	80% Cu. 4	
Sterilizing Temperature	20% Acid	
Sterilizing Time	From M. to M.	From M. to M.
Time start running in fermenter	(11.3)	
Gravity of first current	LCT 17.6	IP 11.93
Acidity of first current	23	18
Gallons in Fermenter	5000	5000

Stocked with 375 Lbs. of No. 137. K- Bacillus B

Yield of Yeast, Net lbs. % Yield

Remaining strength of yeast

1.4% B

Process of Fermentation (A) (C)

	TIME Hours	% BALLG.	°C	ACIDITY			
1	3 30	1.40	27.5	1.5	75	90	11R
2	4 30	1.20	28	1.8			
3	5 30	1.05	28	2.4			
4	6 30	1.00	28	2.9		14	
5	7 30	1.10	28	3.2			
6	8 30	1.20	28	2.8		14	
7	9 30	1.35	28	2.6			
8	10 30	1.45	28	2.8		14	
9	11 30	1.5	28.5	2.8			
10	12 30	1.6	28	3.1	B 12		
11	1 30	1.7	28.5	3.0			
12	2 30	1.85	28.5	3.5	11R		
13	3 30	2.0	29	3.0			
14	4 30	2.15	29	3.4	10		
15	5 30	2.3	29	3.0			
16	6 30	2.4	28.5	3.3		62	
17		2.5	27.5	3.5			
18		4#					
19		3#					
20		3#					

10# A.B on wash tank

12-2 - Acid in " "

12-2. acid in wash tank.

Compressor - running all day

3 Tanks

Feed

3 30 (1)

5 30 (2)

7 30 (3)

2 (4)

5 00 finish O.K.

22½

31½

X

Thins run to separators, From 6 30 M. to 7 30 M. No. of separators 5

Name

Wood Fermenter No. #I

NATIONAL GRAIN YEAST CORPORATION

Mash No. M-560 Manufacturing Process—Table Date Sept 15, 1931

RAW MATERIALS

Malt _____ lbs.
Sprouts _____ lbs.
Corn _____ lbs.
_____ lbs.
Molasses _____ lbs.
_____ lbs.
Am. Phosphate _____ lbs.
Ammonia _____ lbs.
Am. Sulphate _____ lbs.
_____ lbs.

Acid Added
For Neutralization _____
During Fermentation _____
In Liquid Yeast _____

Total Materials _____ lbs.

	Molasses			Grain Mash		
Total gallons molasses and water				Start Filtering		
Sterilizing Temperature				Finish Filtering		
Sterilizing Time						
Time start running in fermenter	From	M. to	M.	From	M. to	M.
Gravity of first extract						
Acidity of first extract						
Gallons in Fermenter						

Stocked with 375 Lbs. of No. 137 K. Bottom B

Yield of Yeast, Net _____ lbs. _____ % Yield

Fermenting strength of yeast _____

Process of Fermentation (A) (C)

	TIME Hours	% BALLG.	°C	ACIDITY			
3 30		1.40	28	1.5	75	20	Feed
1	4 30	1.15	28	1.8			
2	5 30	1.00	28	2.4			4 30 ①
3	6 30	1.00	28	2.8		14	
4	7 30	1.10	28	3.0			6 30 ②
5	8 30	1.25	28	2.9		14	
6	9 30	1.35	28	2.7			8 30 ③
7	10 30	1.45	28	2.8		14	
8	11 30	1.5	28	2.9		B	3 ④
9	12 30	1.6	28.5	3.4		12 =	
10	1 30	1.75	28.5	3.2			
11	2 30	1.9	29	3.5		12	6 ⑤
12	3 30	2.05	29	3.1			finish
13	4 30	2.2	29	2.8		11	9 K.
14	5 30	2.3	28.5	3.0			
15	6 30	2.4	28	3.3			~~32~~
16	7 31	2.45	28	3.6		75	31 1/2
17							
18							
19							X
20							

Time run to separators, From 7 31 M. to 8 30 M. No. of separators _____

Name _____

Wood Fermenter No. 2

NATIONAL GRAIN YEAST CORPORATION

Manufacturing Process—Table

Mash No. M-561 Date Sept 15, 1931

RAW MATERIALS

Malt _____ lbs.
Sprouts _____ lbs.
Corn _____ lbs.
_____ lbs.
Molasses _____ lbs.
_____ lbs.
Am. Phosphate _____ lbs.
Ammonia _____ lbs.
Am. Sulphate _____ lbs.
_____ lbs.

Acid Added
For Neutralization _____
During Fermentation _____
In Liquid Yeast _____

Total Materials _____ lbs.

	Molasses			Grain Marsh		
Total gallons molasses and water				Start Filtering		
Sterilizing Temperature				Finish Filtering		
Sterilizing Time	From	M. to	M.	From	M. to	M.
Time start running in fermenter						
Gravity of first extract						
Acidity of first extract						
Gallons in Fermenter						

Stocked with 375 Lbs. of No. 137 K = Ben B

Yield of Yeast, Net _____ lbs. _____ % Yield

Fermenting strength of yeast _____

Process of Fermentation

	TIME Hours	% BALLG.	°C	ACIDITY	(A)	(C)	Feed
	4 30	1.40	27	1.5	75	20	
1	5 30	1.20	28	1.9			
2	6 30	1.00	28	2.3			5 30 (1)
3	7 30	0.95	28	2.7		14	
4	8 30	1.10	28	2.9			7 30 (2)
5	9 30	1.15	28	2.9		14	
6	10 30	1.3	28	2.6			9 30 (3)
7	11 30	1.4	28.5	3.1		B 12	
8	12 30	1.5	29	3.1			4 00 (2)
9	1 30	1.65	29	3.3		12	
10	2 30	1.8	28.5	3.0			7 00 finish O.K.
11	3 30	1.95	28	3.4		12	
12	4 30	2.05	28	3.1			
13	5 30	2.2	28	3.3		10	
14	6 30	2.3	28	3.1			
15	7 30	2.4	28	3.3		62	
16	8 30	2.4	27	3.3		45	~~32½~~ 31½
17							
18							
19							
20							

Time run to separators, From 8 30 M. to 9 30 M. No. of separators _____

Name _____

Wood Fermenter No. F

Mash to be made Saturday 4/25/31
For Monday 4/27/31
2 Iron F's — Nos M-177-8
2 Wood F's — Nos M-179-80

Materials

Malt - 2100
Sprouts - 2000+300
Molasses - 13,350

26" Molasses
16 L - Acid
65 # Ca-Phos

Chemicals

on 467

A. P. - 320
Amm - 340
A. S - 380

53% to Iron F's
47% to Wood F's

New ~~Mash~~ Sour tub

Sour Mash Treatment

1st day Grain Mash			2nd day Molasses.		
Time	Test	Ammonia			
10	12cc	10 L	3:00 PM	32 cc	16 L

a. P. – 320
am – 340
a. S – 380

53% to Iron 7's
47% to Wood 7's

New Sour tub

Sour Mash Treatment

1st day Grain Mash			2nd day Molasses.		
Time	Test	Ammonia			
10a	12 cc	10 Lv	3:30 PM	32 cc	15 Lv
12n	18 cc	10 Lv	10a	34 cc	15 Lv
2p	20 cc	14 Lv	1a	32 cc	12 Lv
4p	22 cc	14 Lv			42 Lv
6p	24 cc	10 Lv	4a		86 lbs
		64 Lv	6a	30 cc	+128
		128 lbs			214#

Half to 1650 7
New Sour Tub
30 cc

PLAINTIFF'S EXHIBIT P-14.
Photostat of Defendant's Mash Sheet of April 25 to 27, 1931.

NATIONAL GRAIN YEAST CORPORATION

Mash No. M-177 Manufacturing Process—Table Date 4/27/31

RAW MATERIALS

Malt _____ lbs.
Sprouts _____ lbs.
Corn _____ lbs.
_____ lbs.
Molasses _____ lbs.
_____ lbs.
320 Am. Phosphate +19T ✓ lbs.
340 Ammonia (364) ✓ lbs.
380 Am. Sulphate (35 ✓) 162 lbs.
65 _____ lbs.

Total Materials _____ lbs.

Acid Added

For Neutralization _____

During Fermentation _____

In Liquor -467 (B) mash
-364 214 #
-103 +150 wtr
364 #

S&I 50 ✓ + LCT 100 + IP 40 ✓

Molasses

Total gallons molasses and water
Sterilizing Temperature
Sterilizing Time
Time start running in fermenter 11 00 A M
Gravity of first extract
Acidity of first extract
Gallons in Fermenter

From M. to M. (12.00)
VCT 13.6 / 21- 70 ✓
LCT 14.3 / 22- 40 ✓

Grain Mash

Start Filtering 8 00 A M.
Finish Filtering 4 00 P M.
From M. to M. (12.0)
IP 24.2 / 130 15 ✓

Stocked with 400 Lbs. of No. 117K Seed.

Yield of Yeast, Net _____ lbs. _____ % Yield

Fermenting strength of yeast _____

Process of Fermentation (A) (C)

12 =	TIME Hours	% BALLG.	°C	ACIDITY			
		1.00	28.5	1.5	85 ✓	30 ✓	Feed
1	1	0.90	28	1.7			1st (1)
2	2	0.85	28	2.1			
3	3	0.90	28	2.4			3rd (2)
4	4	1.00	28	2.6			
5	5	1.05	28	2.8	7 ✓		7.30 (3)
6	6	1.20	28	3.2			
7	7	1.35	28	4.2			10.30 (4)
8	8	1.5.	28	4.6			
9	9	1.6.	28	4.9	7 ✓		12.30 (5)
10	10	1.7.	28	4.8			
11	11	1.8.5	28	4.1			2nd finish
..	12	2.10.	28	3.6	.. 4		

Acidity of first extract 121-1 ✓ 122-1 ✓ 130 1 ✓

Gallons in Fermenter

Stocked with 400 Lbs. of No. 117K Seed.

Yield of Yeast, Net _____ lbs. _____ % Yield

Fermenting strength of yeast _____

Process of Fermentation (A) (C) ✓

	TIME Hours	BALLG.	°C	ACIDITY		
12 m		1.00	28.5	1.5	85 ✓	30
1	1	0.90	28	1.7		
2	2	0.85	28	2.1		
3	3	0.90	28	2.4		
4	4	1.00	28	2.6		
5	5	1.05	28	2.8	7 ✓	
6	6	1.20	28	3.2		
7	7	1.35	28	4.2		
8	8	1.5.	28	4.6		
9	9	1.6.	28	4.9	7 ✓	
10	10	1.7.	28	4.8		
11	11	1.8.5	28	4.1		
12	12	2.0.	28	3.6	44	
13	1	2.10	28	3.0		
14	2	2.2.	28	2.4	3 lt. acid	
15	3	2.2	28	3.1		
16	4 4 30	2.3.	28	2.3 2.8	3 lt. acid Separating	
17						
18	10 lbs Am Phos in 1st wash tank ✓					
19	8 lbs " " " 2nd " " ✓					
20	2 Liters Acid in each " " ✓					

Feed

1 oz (1)

3 oz (2)

7 30 (3)

10 30 (4)

12 30 (5)

2 oz finish ✓

35½ hrs

Time run to separators, From 4 30 M. to 5 50 M. No. of separators 5

Name

Press Rep. M-173-4 (2nd Tank) — Pressed — HHHII 23/4

" " M-175-6 (Big Tank) — Pressed — HHHII+1+1/4

IRON Fermenter No. I

NATIONAL GRAIN YEAST CORPORATION

Mash No. M-178 Manufacturing Process—Table Date 4/27/31

RAW MATERIALS

Malt _____ lbs.
Sprouts _____ lbs.
Corn _____ lbs.
_____ lbs.
Molasses _____ lbs.
_____ lbs.
Am. Phosphate _____ lbs.
Ammonia _____ lbs.
Am. Sulphate _____ lbs.
_____ lbs.

Total Materials _____ lbs.

Acid Added
For Neutralization _____
During Fermentation _____
In Liquid Yeast _____

Total gallons molasses and water
Sterilizing Temperature
Sterilizing Time
Time start running in fermenter
Gravity of first extract
Acidity of first extract
Gallons in Fermenter

Molasses
From M. to M.

Grain Mash
Start Filtering
Finish Filtering
From M. to M.

Stocked with 400 Lbs. of No. 117K Seed.

Yield of Yeast, Net _____ lbs. _____ % Yield

Fermenting strength of yeast _____

Process of Fermentation (A) (C)

	TIME	% BALLG.	°C	ACIDITY	15✓	30✓	Feed
1/30		1.00	28	1.5			
1	3 Hours	0.85	28	2.0			2 30 (1)
2	4	0.90	28	2.5			
3	5	0.95	28	3.0			4 30 (2)
4	6	1.05	28	3.0			
5	7	1.20	28	3.4	7✓		9 00 (3)
6	8	1.3	28	4.1			
7	9	1.4	28	4.5			12 00 (4)
8	10	1.5	28	4.6			
9	11	1.7	28.5	4.2	7✓		2 00 (5)
..	..	1.4	28	3.7			

Stocked with 400 Lbs. of No. 117K Seed.

Yield of Yeast, Net _____ lbs. _____ % Yield

Fermenting strength of yeast _____

Process of Fermentation

	TIME Hours	% BALLG.	°C	ACIDITY			Feed
1/30		1.00	28	1.5		85 ✓ 30 ✓	
1	3	0.85	28	2.0			2 30 ①
2	4	0.90	28	2.5			4 30 ②
3	5	0.95	28	3.0			
4	6	1.05	28	3.0			9 00 ③
5	7	1.20	28	3.4		7 ✓	
6	8	1.3	28	4.1			12 00 ④
7	9	1.4	28	4.5			
8	10	1.5	28	4.6			2 00 ⑤
9	11	1.7	28.5	4.2		7 ✓	
10	12	1.9	28	3.7			3 20
11	1	2.0	28	2.7		44	finish
12	2	2.1	28	2.0	3 lt. acid		
13	3	2.2	28.5	2.9			35 hrs
14	4	2.2	28	2.7			
15	5	2.3	28	2.3	3 lt. acid.		
16	5 50	2.3	28	2.8	Separating		
17							
18							
19							
20							

Time run to separators, From 5 50 M. to 7 10 M. No. of separators 5

Name _____

Iron Fermenter No. 2

RAW MATERIALS

Malt _____ lbs.
Sprouts _____ lbs.
Corn _____ lbs.
_____ lbs.
Molasses _____ lbs.
_____ lbs.
Am. Phosphate _____ lbs.
Ammonia _____ lbs.
Am. Sulphate _____ lbs.
_____ lbs.

Acid Added
For Neutralization _____
During Fermentation _____
In Liquid Yeast _____

Total Materials _____ lbs.

	Molasses	Grain Mash
Total gallons molasses and water		Start Filtering
Sterilizing Temperature		Finish Filtering
Sterilizing Time	From M. to M.	From M. to M.
Time start running in fermenter		
Gravity of first extract		
Acidity of first extract		
Gallons in Fermenter		

Stocked with 375 Lbs. of No. 117K Seed.

Yield of Yeast, Net _____ lbs. _____ % Yield

Fermenting strength of yeast _____

Process of Fermentation (A) (C)

3 00 TIME Hours	% BALLG. 1.00	°C 28.5	ACIDITY 1.5	75	25	Feed
1 4 00	0.90	28	1.8			4 00 (1)
2 5	0.85	28	2.5			
3 6	0.85	28	3.0			6 00 (2)
4 7	1.00	28	2.8			
5 8	1.1.	28	2.7		6	10 00 (3)
6 9	1.2.5	28	2.8			
7 10	1.4.	28	3.0			2 30 (4)
8 11	1.5.	28	3.2			
9 12	1.6.	28	3.3		6	4 30 finish
10 1 00	1.70	28	3.4			
11 2	1.9.	28	3.6			
12 3	2.0.	28.5	3.9		37	31½
13 4	2.1.	28.5	3.3			
14 5	2.2.	28	2.6			
15 6	2.20	28	2.2	3 lbs. acid		
16 7 10	2.20	27	2.5	separating		
17			2			

Gallons in Fermenter

Stocked with 375 Lbs. of No. 117K Seed.

Yield of Yeast, Net _____ lbs. _____ % Yield

Fermenting strength of yeast _____

Process of Fermentation (A) (C)

30 TIME Hours	% BALLG. 1.00	°C 28.5	ACIDITY 1.5	7.7	25		Feed
1 4	0.90	28	1.8				
2 5	0.85	28	2.5				4 oz (1)
3 6	0.85	28	3.0				
4 7	1.00	28	2.8				6 oz (2)
5 8	1.1.	28	2.7		6		
6 9	1.2.5	28	2.8				10 oz (3)
7 10	1.4.	28	3.0				
8 11	1.5.	28	3.2				2 30 (4)
9 12	1.6.	28	3.3		6		
10 1	1.70	28	3.4				4 30 finish
11 2	1.9.	28	3.6				
12 3	2.0.	28.5	3.9		37		31½
13 4	2.1.4	28.5	3.3				
14 5	2.2.	28	2.6				
15 6	2.120	28	2.2	3 lb. acid			
16 7 10	2 20	27	2.5 2	separating			
17							
18							
19							
20							

Time run to separators, From 7 10 M. to 8 10 M. No. of separators 5

Name _____

Wood Fermenter No. I

NATIONAL GRAIN YEAST CORPORATION

Manufacturing Process—Table

Mash No. M-180 Date 4/27/31

RAW MATERIALS

Malt _____ lbs.
Sprouts _____ lbs.
Corn _____ lbs.
_____ lbs.
Molasses _____ lbs.
_____ lbs.
Am. Phosphate _____ lbs.
Ammonia _____ lbs.
Am. Sulphate _____ lbs.
_____ lbs.

Acid Added

For Neutralization _____
During Fermentation _____
In Liquid Yeast _____

Total Materials _____ lbs.

	Molasses			Grain Mash		
Total gallons molasses and water				Start Filtering		
Sterilizing Temperature				Finish Filtering		
Sterilizing Time	From	M. to	M.	From	M. to	M.
Time start running in fermenter						
Gravity of first extract						
Acidity of first extract						
Gallons in Fermenter						

Stocked with 375 Lbs. of No. 117K Seed

Yield of Yeast, Net _____ lbs. _____ % Yield

Fermenting strength of yeast _____

Process of Fermentation (A) (C)

400 TIME Hours	% BALLG.	°C	ACIDITY	737	25	Feed
1 ✓00	1.20 1.15	28 28	1.5 2.4			
2 6	1.10	28	3.9			5 oz (1)
3 7	1.05	28	3.8			
4 8	1.1	28	4.2			7 oz (2)
5 9	1.2	28	4.0		6 ✓	
6 10	1.3	28	3.6			11 oz (3)
7 11	1.4	28	3.3			
8 12	1.5	28	3.5			3 30 (4)
9 1	1.60	28	3.6		6 ✓	5 30
10 2	1.8	28	3.9			finish
11 3	1.0	30	4.1		✓	

Gallons in Fermenter

Stocked with 375 Lbs. of No. 117K Seed.

Yield of Yeast, Net lbs. % Yield

Fermenting strength of yeast

Process of Fermentation (A) (C)

TIME Hours	% BALLG.	°C	ACIDITY	737	25	Feed
400	1.20	28	1.5			
1 ✓00	1.15	28	2.4	✓	✓	
2. 6	1.10	28	3.3			5[30] (1)
3 7	1.05	28	3.8			
4 8	1.1	28	4.2			7[30] (2)
5 9	1.2	28	4.0		6 ✓	
6 10	1.3	28	3.6			11[30] (3)
7 11	1.4	28	3.3			
8 12	1.5	28	3.5			3[30] (4)
9 1	1.60	28	3.6		6 ✓	
10 2	1.8	28	3.9			5[30]
11 3	1.90	28	3 4			finish ✓
12 4	2.10	28	2.3	2 lts acid.	37	31½ hrs
13 5	2.20	28	2.5			
14 6	2.20	28	2.8	2 lt. acid.		
15 7	2.20	27.5	2.8			
16 8[10]						
17						
18						
19						
20						

Time run to seperators, From 8[10] M. to 9[10] M. No. of seperators 5

Name

Wood Fermenter No. 2

Mash

Wednesday ~~Nov~~ ~~Dec.~~ 7th for
Friday ~~Nov~~ ~~Dec.~~ 9th

1- 1st gen Seed	6- conc F's
199- 1G (M)	3539 to 3544 Inc

Two Molasses Mashes

Malt	3,600# ✓			
		1,500	(1) ✓	
Sprouts	3,900			
		2,400	(2) ✓	
Molasses	23,000			

			Xtra Mol.
	~~[illegible]~~"	Molasses	22½" + 5"
each	~~[illegible]~~	Liters Acid	18 L ✓ + 4 L.
	~~[illegible]~~	Ca. Phosphate	48# ✓ + 6#

2,500 Gallons (S.C.T.)
16# (a)
30# (c)

16,500 Gallons (Wood Tank)
257# (c)
60 L (B)

	B
1.00 A.M. 19 - cc	12 L. ✓
2.30 A.M. 19 - cc	14 " ✓
4.00 A.M. 20 - cc	16 " ✓
5.30 A.M. 19 - cc	18 " ✓
7.00 A.M. 20 - cc	22 " ✓

10.00 A.M. 20 L. ✓

	B
100 PM.	20 L. ✓
3.30 PM - 20.00	20 " ✓
6.30 PM 20.00	~~14~~ " ✓
9.30 PM = 20.00	12 " ✓
1.00 A.M. 20 - cc	10 " ✓
6.00 A.M. 20 - cc	

Heat to 170 F.

PLAINTIFF'S EXHIBIT P-15.
Photostat of Defendant's Mash Sheet of December 7 to 9, 1932.

Friday

1- 1st gen Seed. 199- 1G (M)	6- conc Ls 3539 to 3544 Inc

Two Molasses Mashes

Malt	3,600# ✓	1,500 (1) ✓	each	[illegible]" Molasses 22½" + 5" Xtra Mol.
Sprouts	3,900	2,400 (2) ✓		[illegible] Liters Acid 18 L ✓ + 4 L.
Molasses	23,000			[illegible] Ca. Phosphate 48# ✓ + 6#

2,500 Gallons (S.C.T.)	16,500 Gallons (Wood Tank)
16# (a)	257# (c)
30# (c)	60 L (B)

	B		B
1.00 A.M. 19 - cc	12 L. ✓	100 PM.	20 L. ✓
2.30 A.M. 19 - cc	14 " ✓	3.30 PM - 20.00	20 " ✓
4.00 A.M. 20 - cc	16 " ✓	6.30 PM 20.00	14 " ✓
5.30 A.M. 19 - cc	18 " ✓	9.30 PM = 20.00	12 " ✓
7.00 A.M. 20 - cc	22 " ✓	1.00 A.M. 20 - cc	10 " ✓
		6.00 A.M. 20 - cc	

10.00 A.M. 20 L. ✓

Heat to 170 F. ✓

PLAINTIFF'S EXHIBIT P-15.
Photostat of Defendant's Mash Sheet of December 7 to 9, 1932.

PROCESS TABLE

Mash No. 3539 Date 12/9/32

RAW MATERIALS

Malt ..... lbs.
Sprouts ..... lbs.
..... lbs.
Molasses ..... lbs.
..... lbs.
A ..... lbs.
B ..... lbs.
C ..... lbs.
D ..... lbs.
C. P. ..... lbs.

Total Materials ..... lbs.

WORT STORAGE

16,500 Gallons Wood.
A ..... lbs.
B ..... lbs. 602 ✓
C 257 lbs. ✓

Gravity 11.9 — % Ball.
Acidity 4.0 — C.C.

B. in Mash ..... lbs.

Stocked with 7/4" J-Y Lbs. of Seed No. 197-26 (5)
Yield—Net Lbs. % Yield
Baking Test—
Remarks—

TIME Hours	GRAVITY % BALLG.	°C	ACIDITY	pH	A	B	C	D	ACID ADDED
12 30	1.30	28	1.6		50 ✓		20 ✓		
1								20 ✓	1.30 (3) ✓
2	1.20	28	2.6					15 ✓	
3	1.30	26	2.4	4.54					3 30 (4) ✓
4	1.40	28	2.4	4.54			9 ✓	15 ✓	
5	1.55	28	2.7						5 30 (5) ✓
6	1.75	29	2.1				9 ✓	8 ✓	
7	1.70	20	2.7				9 ✓		7 45 Stop
7 45	1.70	29	2.7						
8									
9									

AT 6 15 ✓ M. STOP COOLERS AND ADD WATER
AT 7 45 M. BACK ½ INTO [redacted] FERMENTER NO. II

10	8 30	29	2.7				10 ✓		8 30 (2) ✓

Baking Test—

Remarks—

	TIME Hours	GRAVITY % BALLG.	°C	ACIDITY	pH	A	B	C	D	ACID ADDED
1	12 30	1.30	28	1.6		50 ✓		20 ✓		
2	2	1.20	28	2.6					20 ✓	1.30 (3) ✓
3	3	1.30	28	2.4	4.54				15 ✓	
4	4	1.40	28	2.4	4.54			9 ✓	15 ✓	3 30 (4) ✓
5	5	1.55	28	2.7						5 30 (5) ✓
6	6	1.75	29	2.1				9 ✓	8 ✓	
7	7	1.70	20	2.7				9 ✓		7 45 Stop
8	7 45	1.70	29	2.7						
9										
10	8 30		29	2.7				10 ✓		8 00 (2) ✓
11	9	1.55	29	2.7					8 ✓	
12	10	1.40	28	2.5						8 15 (4) ✓
13	11	1.50	28	2.5				6 ✓		11 15 (3) ✓
14	12	1.65	28	2.5						
15	1 15	1.75	27.5	2.5						11 45 Stop ✓
16										
17										
18										

AT 6 15 ✓ M. STOP COOLERS AND ADD WATER

AT 7 45 ✓ M. BACK ½ INTO [redacted] FERMENTER NO. II

CUT DOWN AIR AT— 11 45 ✓ M. ACID IN WASH WATER 2 ✓ LITERS

TIME FOR SEPARATING—FROM 1 15 ✓ M. TO 1 51 ✓ M.

PUT WASHED YEAST INTO RECEIVER NO. 4

word 4

FERMENTER NO.

PROCESS TABLE

Mash No. 3540 Date 12/9/32

RAW MATERIALS

Malt ..... lbs.
Sprouts ..... lbs.
..... lbs.
Molasses ..... lbs.
..... lbs.
A ..... lbs.
B ..... lbs.
C ..... lbs.
D ..... lbs.
C. P. ..... lbs.

WORT STORAGE

..... Gallons .....
A ..... lbs. .....
B ..... lbs. .....
C ..... lbs. .....

Gravity ..... % Ballg.
Acidity ..... C. C. .....

B. in Mash ..... lbs.

Total Materials ..... lbs.

Stocked with ~~7/9~~ "725 Bulb (J-1) Lbs. of Seed No. 197-26 (2-3)

Yield—Net ..... Lbs. ..... % Yield

Baking Test—

Remarks—

	TIME Hours	GRAVITY % BALLG.	°C	ACIDITY	pH	A	B	C	D	ACID ADDED	
	1 15	1.30	28	1.6		50 ✓		20 ✓			
1	2 15	1.20	28	2.6					20 ✓		2 15 (3) ✓
2	3	1.30	28	2.6	4.24				15 ✓		
3	4	1.40	28	2.4	4.54						4 15 (4) ✓
4	5	1.50	28	2.4				9 ✓	15 ✓		
5	6	1.65	28	2.5				9 ✓	8 ✓		6 15 (5) ✓
6	7	1.80	29	2.7				9 ✓			
7	8	1.75	29	2.7							8 30 Stop ✓
8	8 30	1.75	29	2.[illegible]							
9											

AT 7 00 ✓ M. STOP COOLERS AND ADD WATER

AT 8 30 M. BACK ½ INTO Iron FERMENTER NO. II

10											
11	10	1.60	29	2.5				10 ✓			8 45 (2) ✓

Yield—Net ..... Lbs. ..... % Yield

Baking Test—

Remarks—

	TIME Hours	GRAVITY % BALLG.	°C	ACIDITY	pH	A	B	C	D	ACID ADDED
	1 15	1.30	28	1.6		50 ✓		20 ✓		
1	2 15	1.20	28	2.6					20 ✓	
2	3	1.30	28	2.6	4.24				15 ✓	2 15 (3) ✓
3	4	1.40	28	2.4	4.54			9 ✓	15 ✓	4 15 (4) ✓
4	5	1.50	28	2.4						
5	6	1.65	28	2.5				9 ✓	8 ✓	6 15 (5) ✓
6	7	1.80	29	2.7				9 ✓		
7	8	1.75	29	2.1						8 30 ✓
8	8 30	1.75	27	2.1						Acty
9										

AT ..... 7 ✓ ..... M. STOP COOLERS AND ADD WATER

AT ..... 8 30 ..... M. BACK ½ INTO ..... FERMENTER NO. II

10										
11	10	1.60	29	2.5				10 ✓		8 45 (2) ✓
12	11	1.50	28	2.4					8 ✓	
13	12	1.65	28	2.4						9 00 (4) ✓
14	1	1.75	28	2.4					6 ✓	
15	1 55	1.85	27	2.4						12 00 (3) ✓
16										12 30 ✓
17										Acty
18										

CUT DOWN AIR AT— 12 30 ✓ M. ACID IN WASH WATER ..... LITERS

TIME FOR SEPARATING—FROM 1 55 ✓ M. TO 2 40 ✓ M.

PUT WASHED YEAST INTO RECEIVER NO. 4

Wood

FERMENTER NO. I

67

PROCESS TABLE

Mash No. 3541 Date 12/9/32

RAW MATERIALS

Malt ..... lbs.
Sprouts ..... lbs.
..... lbs.
Molasses ..... lbs.
..... lbs.
A ..... lbs.
B ..... lbs.
C ..... lbs.
D ..... lbs.
C. P. ..... lbs.

Total Materials ..... lbs.

WORT STORAGE

..... Gallons .....
A ..... lbs. .....
B ..... lbs. .....
C ..... lbs. .....
.....
Gravity ..... % Ballg.
Acidity ..... C.C. .....

B. in Mash ..... lbs.

Stocked with ..... Lbs. of Seed No. .....
Yield—Net ..... Lbs. ..... % Yield
Baking Test— .....
Remarks— .....

	TIME Hours	GRAVITY % BALLG.	°C	ACIDITY	pH	A	B	C	D	ACID ADDED
1										
2										
3										
4										
5										
6										
7										
8										
9										

AT ..... M. STOP COOLERS AND ADD WATER

AT ..... M. BACK ½ INTO ..... FERMENTER NO. .....

10										
11	9	1.30	81	2.3						
12	10	1.11	82	1.5						

Stocked with ..... Lbs. of Seed No. .....

Yield—Net ..... Lbs. ..... % Yield

Baking Test— .....

Remarks— .....

	TIME Hours	GRAVITY % BALLG.	°C	ACIDITY	pH	A	B	C	D	ACID ADDED	
1											
2											
3											
4											
5											
6											
7											
8											
9											

AT ..... M. STOP COOLERS AND ADD WATER

AT ..... M. BACK ½ INTO ..... FERMENTER NO. .....

10						
11	9	1.30	21	2.3		8.00 (5)
12	10	1.45	21	2.5	6.15	8.30 (6)
13	11	1.60	28	2.8	6.12	9.00 (7)
14	12	1.70	28	2.8	9	12.00 (6)
15	1	1.85	28	2.6		12.30 (4)
16	2	1.90	27.5	2.5		1.10 Stop
17	2.40	1.95	27	2.5		
18						

CUT DOWN AIR AT— 1.10 M. ACID IN WASH WATER ..... LITERS

TIME FOR SEPARATING—FROM 2.40 M. TO 3.55 M.

PUT WASHED YEAST INTO RECEIVER NO. 4

Iron II

FERMENTER NO. .....

PROCESS TABLE

Mash No. 3542 Date 12/9/32

RAW MATERIALS

Malt ..... lbs.
Sprouts ..... lbs.
..... lbs.
Molasses ..... lbs.
..... lbs.
A ..... lbs.
B ..... lbs.
C ..... lbs.
D ..... lbs.
C. P. ..... lbs.

WORT STORAGE

..... Gallons .....
A ..... lbs. .....
B ..... lbs. .....
C ..... lbs. .....

Gravity ..... % Ballg.
Acidity ..... C.C. ....

B. in Mash ..... lbs.

Total Materials ..... lbs.

Stocked with 150# Buck J - 5" J-2 Lbs. of Seed No. 197-26 (2-8) 187-28 (5)

Yield—Net ..... Lbs. ..... % Yield

Baking Test—

Remarks—

	TIME Hours	GRAVITY % BALLG.	°C	ACIDITY	pH	A	B	C	D	ACID ADDED	
	3 45	1.30	27	1.6		50		20			
1	5	1.10	28	2.6					20		4 45 (2)
2	6	1.20	28	2.5					15		
3	7	1.35	28	2.5				9	15		5 45 (3)
4	8	1.50	28	2.5				9	8		8 45 (4)
5	9	1.65	28	2.7				9			
6	10	1.80	29	2.9							11 45 Stop
7	11	1.75	29	3.0							
8	11 45	1.70	29	3.0							
9											

AT 10 15 M. STOP COOLERS AND ADD WATER

AT 11 45 M. BACK ½ INTO Iron FERMENTER NO. I

10											
11	1	1.45	28	2.6							12 00 (2)

Stocked with 5" J-2 Lbs. of Seed No. 197-2E (1-1)

Yield—Net ..... Lbs. 197-2E (2-1) % Yield

Baking Test—

Remarks—

	TIME Hours	GRAVITY % BALLG.	°C	ACIDITY	pH	A	B	C	D	ACID ADDED
	3 45	1.30	27	1.6		50		20		
1	5	1.10	28	2.6					20	4 45 (2)
2	6	1.20	28	2.6					15	
3	7	1.35	28	2.65				9	15	5 45 (3)
4	8	1.50	28	2.5				9	8	8 45 (4)
5	9	1.65	28	2.7				9		11 45 Stop
6	10	1.80	29	2.9						
7	11	1.75	29	3.0						
8	11 45	1.70	29	3.0						
9										

AT 10 45 M. STOP COOLERS AND ADD WATER

AT 11 45 M. BACK ½ INTO Ferm FERMENTER NO. 1

10										
11	1	1.45	28	2.6				6		12 45 (2)
12	2	1.45	28	2.6				3		
13	3	1.55	28.5	2.6				4	5	1 45 (4)
14	4	1.65	28.5	2.6				1	9	3 45 (3)
15	5	1.80	28.5	2.7						4 45 (2)
16	6 30	1.90	27	2.6						5 45 Stop
17										
18										

CUT DOWN AIR AT— 5 00 M. ACID IN WASH WATER 9 LITERS

TIME FOR SEPARATING—FROM 6 30 M. TO 7 00 M.

PUT WASHED YEAST INTO RECEIVER NO. 3

Wood 2

FERMENTER NO.

PROCESS TABLE

Mash No. 3543 Date 12/9/32

RAW MATERIALS

Malt ..... lbs.
Sprouts ..... lbs.
..... lbs.
Molasses ..... lbs.
..... lbs.
A ..... lbs.
B ..... lbs.
C ..... lbs.
D ..... lbs.
C. P. ..... lbs.

Total Materials ..... lbs.

WORT STORAGE

..... Gallons .....
A ..... lbs. .....
B ..... lbs. .....
C ..... lbs. .....
.....
Gravity ..... % Ballg.
Acidity ..... C.C. .....

B. in Mash ..... lbs.

Stocked with 6¼" ✓ - 2 Lbs. of Seed No. 197-2G(r)

Yield—Net ..... Lbs. ..... % Yield

Baking Test— .....

Remarks— .....

	TIME Hours	GRAVITY % BALLG.	°C	ACIDITY	pH	A	B	C	D	ACID ADDED
	4 30	1.13	27	1.6		50 ✓		20 ✓		
1	6	1.10	28	2.6				20 ✓		5 30 ② ✓
2	7	1.25	28	2.3				15 ✓		
3	8	1.40	28	2.3						6 30 ③ ✓
4	9	1.55	28	2.5				9 ✓ 15 ✓		
5	10	1.65	28	2.9						9 30 ④ ✓
6	11	1.75	29	3.0				9 ✓ 8 ✓		
7	12	1.75	29	3.0						12 30 ✓ stop
8	12 32	1.70	29	3.0				9 ✓		
9								✓		

AT 11 00 ✓ M. STOP COOLERS AND ADD WATER

AT 12 30 ✓ M. BACK ½ INTO Iron FERMENTER NO. I

10										
11	2	1.45	28	2.5				✓		12 45 ⑤

Stocked with 6¼" V-2 Lbs. of Seed No. 197-2G(V)

Yield—Net Lbs. % Yield

Baking Test—

Remarks—

	TIME Hours	GRAVITY % BALLG.	°C	ACIDITY	pH	A	B	C	D	ACID ADDED
	4 30	1.3	27	1.6		50		20		
1										
2	6	1.10	28	2.6					20	5 30 (2)
3	7	1.25	28	2.3					15	
4	8	1.40	28	2.3						6 30 (3)
5	9	1.55	28	2.5					9 15	
6	10	1.65	28	2.9						9 30 (4)
7	11	1.75	29	3.0					9 8	
8	12	1.75	29	3.0						12 30 Stop
9	12 32	1.70	29	3.0					9	

AT 11 00 M. STOP COOLERS AND ADD WATER

AT 12 30 M. BACK ½ INTO Iron FERMENTER NO. I

10										
11	2	1.45	28	2.5					6	12 45 (2)
12	3	1.45	28	2.5					4 45	1 45 (4)
13	4	1.55	28	2.5					9	2 45 (3)
14	5	1.65	28.5	2.6						4 45 (2)
15	6	1.75	28	2.6						5 45 Stop
16	7 10	1.85	27	2.6						
17										
18										

CUT DOWN AIR AT— 5 45 M. ACID IN WASH WATER LITERS

TIME FOR SEPARATING—FROM 7 10 M. TO 7 50 M.

PUT WASHED YEAST INTO RECEIVER NO. 3

Wood 3

FERMENTER NO.

PROCESS TABLE

Mash No. 3544 Date 12/9/32

RAW MATERIALS

Malt ..... lbs.
Sprouts ..... lbs.
..... lbs.
Molasses ..... lbs.
..... lbs.
A ..... lbs.
B ..... lbs.
C ..... lbs.
D ..... lbs.
C. P. ..... lbs.

Total Materials ..... lbs.

WORT STORAGE

..... Gallons.....
A ..... lbs. .....
B ..... lbs. .....
C ..... lbs. .....
.....
Gravity ..... % Ballg.
Acidity ..... C.C.....

B. in Mash ..... lbs.

Stocked with ..... Lbs. of Seed No. .....
Yield—Net ..... Lbs. ..... % Yield
Baking Test— .....
Remarks— .....
.....

TIME Hours	GRAVITY % BALLG.	°C	ACIDITY	pH	A	B	C	D	ACID ADDED
1									
2									
3									
4									
5									
6									
7									
8									
9									

AT ..... M. STOP COOLERS AND ADD WATER

AT ..... M. BACK ½ INTO ..... FERMENTER NO. .....

10

Yield—Net ..... Lbs. ..... % Yield

Baking Test—

Remarks—

TIME Hours	GRAVITY % BALLG.	°C	ACIDITY	pH	A	B	C	D	ACID ADDED
1									
2									
3									
4									
5									
6									
7									
8									
9									

AT ..... M. STOP COOLERS AND ADD WATER

AT ..... M. BACK ½ INTO ..... FERMENTER NO. .....

10							
11	1	1.30	28	2.4	10	11.50	(3)
12	2	1.45	28.5	2.6	10	1.20	(6)
13	3	1.55	28.5	2.6	10	2.50	~~(7)~~
14	4	1.70	28	2.6	6	4.20	(6)
15	5	1.80	28	2.6		5.20	(4)
16	6	1.90	28	2.6			
17	7	1.95	28	2.5			
18	7.50	1.95	27	2.5		6.20	Stop

CUT DOWN AIR AT— 6.20 M. ACID IN WASH WATER ..... LITERS

TIME FOR SEPARATING—FROM 7.50 M. TO ..... M.

PUT WASHED YEAST INTO RECEIVER NO. 3

Irm

FERMENTER NO. I

Seed

PROCESS TABLE

Mash No. 199-1G (M)

Date 12/9/32

RAW MATERIALS

Malt ..... lbs.
Sprouts ..... lbs.
..... lbs.
Molasses ..... lbs.
..... lbs.
A ..... lbs.
B ..... lbs.
C ..... lbs.
D ..... lbs.
C. P. ..... lbs.

Total Materials ..... lbs.

WORT STORAGE

2500 Gallons S.C.T
A 16 lbs. ✓
B ..... lbs.
C 30 lbs. ✓

Gravity 13.0 - % Ballg.
Acidity 8.0 - C.C.

B. in Mash 60 lbs.

Stocked with Copper Pref. P.C. Lbs. of Seed No. 3300 gals
Yield—Net ..... Lbs. ..... % Yield
Baking Test—
Remarks— Press Report
M-3533-34-35-36 - 11 forms 1" M-3537-8 [illegible] - 7 forms 7"

Seed - 199-1B 32" J-1

	TIME Hours	GRAVITY % BALLG.	°C	ACIDITY	pH	A	B	C	D	ACID ADDED
	11.00	6.20	27	3.5		25 ✓		85 ✓		
1	12	5.90	27	4.0						
2	1	5.70	27	4.7						
3	2	5.30	27	5.6						
4	3	5.00	27	6.4				2 Pails ✓		
5	4	4.60	27	7.3				3 " ✓	15 ✓	
6	5	4.10	27	8.0				4 " ✓		
7	6	3.60	27	9.5				4 " ✓	15 ✓	
8	7	3.40	27	9.5				4 " ✓		
9	8	3.30	27	9.0				4 " ✓	15 ✓	
								60th in Bbl		

12.30 (2) ✓
1.30 (3) ✓
2.30 (4) ✓
4.30 (5) ✓
5.30 (6) ✓
8.00 (3) ✓

AT ..... M. STOP COOLERS AND ADD WATER 9.00 Stop ✓
AT ..... M. BACK ½ INTO ..... FERMENTER NO. .....

10

Stocked with Copper Pref. P.C. Lbs. of Seed No. 3300 gals

Yield—Net Lbs. % Yield

Baking Test—

Remarks— Press Report

M-3533-34-35-36 — 11 presses 1" M-3537-8 [illegible] 7 presses 7"

Seed-199-1B 32" J-1

	TIME Hours	GRAVITY % BALLG.	°C	ACIDITY	pH	A	B	C	D	ACID ADDED	
	11.00	6.20	27	3.5		25 ✓		85 ✓			
1	12	5.90	27	4.0							12.30 (2) ✓
2	1	5.70	27	4.7							1.30 (3) ✓
3	2	5.30	27	5.6							2.30 (4) ✓
4	3	5.00	27	6.4				2 Pails ✓			4.30 (5) ✓
5	4	4.60	27	7.3				3 " ✓	15 ✓		5.30 (6) ✓
6	5	4.10	27	8.0				4 " ✓			8.00 (3) ✓
7	6	3.60	27	9.5				4 " ✓	15 ✓		
8	7	3.40	27	9.5				4 " ✓			
9	8	3.20	27	9.0				4 " ✓	15 ✓		
								60th in Bal			

AT ..... M. STOP COOLERS AND ADD WATER 9.00 Stop ✓

AT ..... M. BACK ½ INTO ..... FERMENTER NO. .....

10				
11	9	3.20	27	9.0
12	10	3.30	27	8.0
13	10.30	3.20	27	8.0
14				
15				
16				
17				
18				

1st Gen Seed - Circulate + Wash in Iron F # I + Copper tank No. I ✓

Steam out lines at 9.30 PM ✓

CUT DOWN AIR AT— 9.00 M. ✓ ACID IN WASH WATER 2 LITERS

TIME FOR SEPARATING—FROM 10.30 M. TO 11.30 M.

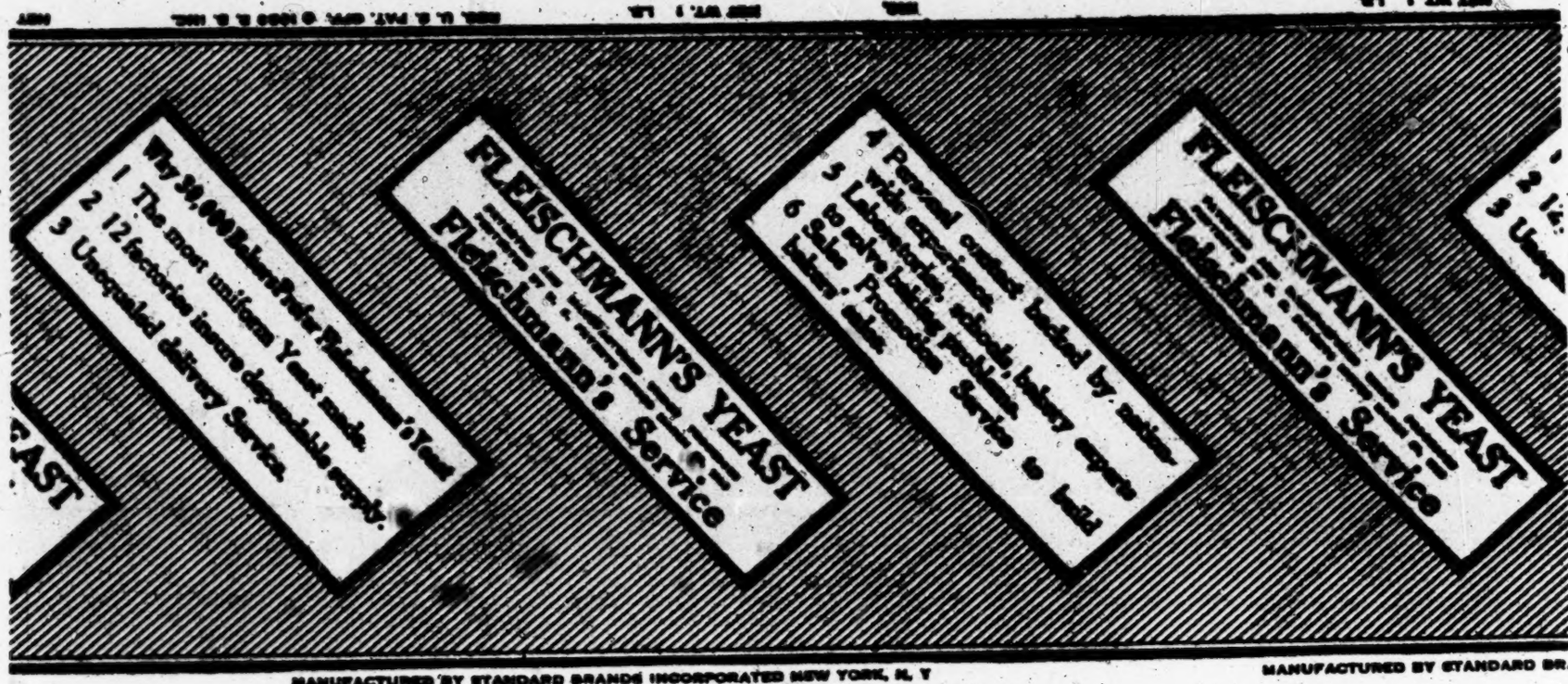
PUT WASHED YEAST INTO RECEIVER NO.

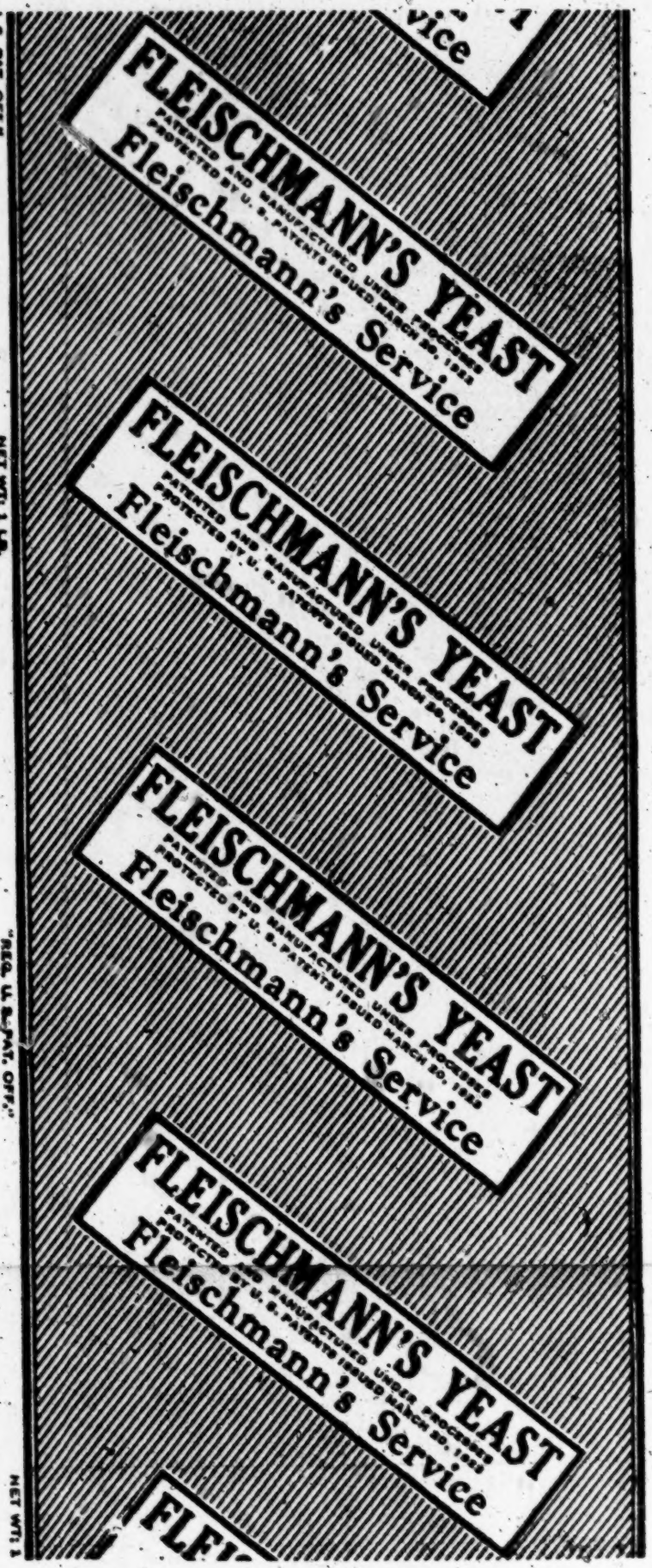
Iron

FERMENTER NO. I

PLAINTIFF'S EXHIBIT P-16.

Wrapper Labeled "Fleischmann Yeast, Patented and Manufactured Under Processes Protected by United States Patents Issued March 20, 1923."




FLEISCHMANN'S YEAST
PATENTED AND MANUFACTURED UNDER PROCESSES PROTECTED BY U. S. PATENTS ISSUED MARCH 20, 1923
Fleischmann's Service
NET WT. 1 LB.
"REG. U. S. PAT. OFF."

Form 42-11-A-5m-11-21

LIBERTY YEAST CORPORATION

(_____ PLANT

YEAST MANUFACTURE PROCESS-TABLES

Mash No. 784 Raw Materials

_____ lbs.

_____ lbs.

Beet molasses _____ Gals. _____ lbs. Date May 19 1923

For neutralization _____ Liters. _____ lbs.

Ammonium Phosphate _____ 30 lbs.

Aqua Ammonia _____ 66 lbs.

Total Material _____ lbs.

Filtercel _____ 42 lbs.

Total Gallons Molasses and Water	
Sterilizing Temperature	
Sterilizing Time. From _____ m. to _____ m.	
Time start running in fermenter	
Gravity of first extract	20.4
Acidity " " "	27 cc
Gallons in fermenter 100 -114	56.33
Amount of Stock: lbs. and brand 100 -115	

Acid added to liquid yeast obtained _____ liters.

Time of pressing yeast _____ hours.

Amount of yeast obtained, net _____ lbs. _____ % yield

Fermenting strength of yeast _____

Process of Fermentation.

	TIME Half Hours	% BALLG.	TEMPERATURE	ACIDITY	ADDITIONS H 2 SO 4	ADDITIONS NH 4 OH	
	6 30 PM	18	24	19	10	3	12
1	7 30	18	25	20			12
2	8 30	17	26	27			12
3	9 30	16	27	32		3	12
4	10 30	15	27	36		3	12
5	11 30	14	27	40		3	12
6	12 30	13	27	44	4	3	12
7	1 30	13	27	46	2	3 3	12
8	2 30	13	27	37	2	2 3	12
9	3 30	14	27	20	4	2	12
10	4 30	15	27	15	5	2	12

Mash Ins

Photostat E

Amount of Stock: lbs. and brand 100 - 115

Acid added to liquid yeast obtained _____ liters.

Time of pressing yeast _____ hours.

Amount of yeast obtained, net _____ lbs. _____ % yield

Fermenting strength of yeast

Process of Fermentation.

	TIME Hrs	Hours	BALLG.	TEMPERATURE	ACIDITY	ADDITIONS H_2SO_4	ADDITIONS NH_4OH	
	6	PM	18	24	19	10 c	3 c	12
1	7	30	18	25	23			12
2	8	30	17	26	27			12
3	9	30	16	27	32		3 c	12
4	10	30	15	27	36		3 c	12
5	11	30	14	27	40		3 c	12
6	12	00	13	27	44	4 c	3 c	12
7	1	30	13	27	46	2	3 c	—
8	2	00	13	27	37	2 c	3 c 2 c	12
9	3	00	14	27	20	4 c	3 c 2 c	12
10	4	30	15	27	15	5 c	2 c	12
11	6	00	17	27	24	5 c	1 c	12
12	6	30	17	27	29	5 c	2 c	12
13	7	30	21	27	34	2 c		12
14	8	30	23	27	42	5 c		12
15	9	30	23	27	30			12
16	10	30	23	27	27			12
17	11	30	23	27	25			12
18	12	00 PM	23	23	20			
19								
20								
21								

Mash In

Run

Roll

Time run to separators 12 30 P m.

PLAINTIFF'S EXHIBIT P-17.
Photostat Entitled Liberty Yeast Corporation, Dated May 19, 1923.

Form 43-2m-4-22

LIBERTY YEAST CORPORATION

(GLOBE PLANT)

YEAST MANUFACTURE PROCESS-TABLES

Seed Yeast No.

Mash No. 1333 Raw Materials Date Jan. 8th 1923.

Corn	709	lbs.			
Malt	776	lbs.			
Sprouts	440	lbs.	H_2SO_4		
Rye	8	lbs.	For Neutralization	1333	cc
Beet molasses Gals.	2334	lbs.	During Fermentation	6000	cc
		lbs.	Added to Liquid Yeast	1300	cc
Ammonium Phosphate	50	lbs.			
Aqua Ammonia	20	lbs.			
	20	lbs.			
Total Material		lbs.	153 @ 4:15 A.M.		

	BEET MOLASSES	GRAIN MASH
Total Gallons Molasses and Water		Pumped to filter M. 7:50 A.M.
Sterilizing Temperature		Finished filtering M. 14.5
Sterilizing Time From M. to M.		Last water °Blg 25.5
Time start running in fermenter		10944
Gravity of first extract		# 421
Acidity " " "		
Gallons in fermenter		
Stocked with	240 #	

Amount of yeast obtained, net lbs. 6449-50 46.5 % yield

Fermenting strength of yeast 26.6 1330-31-32-33-34

Process of Fermentation. January 9th, 1923.

TIME Half	Hours	BALLG.	TEMPERATURE	ACIDITY	ADDITIONS H_2SO_4	ADDITIONS NH_4OH
	10:00 A.M.	3.6	20	4.7		
1	11:00	3.5	20.5	3.4		
2	12:00	3.5	21.5	3.2		
3	1:00	3.3	22.5	3.5		
4	2:00	3.1	23.5	3.9		
5	3:00	2.8	25.	4.7	Shift Change	
6	4:00	2.4	26.	5.9		5
7	5:00	1.9	27	7.0		
8	6:00	1.7	28	7.5		
9	7:00	1.6	28	6.8		

Photosta

Sterilizing time: From M. to M.		
Time start running in fermenter		7:50 A.M.
Gravity of first extract		14.3
Acidity " " "		25.5
Gallons in fermenter		10944
Stocked with	240 #	# 421

Amount of yeast obtained, net lbs. 46.5 % yield

Fermenting strength of yeast 26.6 6449-50 1330-31-32-33-34

Process of Fermentation. January 9th, 1923.

	TIME Hall	Hours	BALLG.	TEMPERATURE	ACIDITY	ADDITIONS H 2 SO 4	ADDITIONS NH 4 OH
	10:00	A.M.	3.6	20	4.7		
1	11:00		3.5	20.5	3.4		
2	12:00		3.5	21.5	3.2		
3	1:00		3.3	22.5	3.5		
4	2:00		3.1	23.5	3.9		
						Shift Change	
5	3:00		2.8	25.	4.7		
6	4:00		2.4	26	5.9		5
7	5:00		1.9	27	7.0		
8	6:00		1.7	28	7.5		
9	7:00		1.6	28	6.8		
10	8:00		1.6	28	6.4		5
11	9:00		1.6	28	5.6		
12	10:00		1.6	28.5	4.2		
						Shift Change	
13	11:00		1.6	28.5	2.8	2	
14	12:00		1.6	28	2.8	2	
15	1:00		1.6	28	2.8	2	
16	2:00		1.6	28	3.0		
17							
18							

Time run to separators, From 2:00 A m. to 3:20 A m. No. of separators 13.

Name

Fermenter No. 12.

PLAINTIFF'S EXHIBIT P-18.

Photostat of Liberty Yeast Corporation "Mash Sheet", (Globe Plant) Dated January 8, 1923.

PLAINTIFF'S EXHIBIT P-19.
Dr. Lamb's Calculation.

Claydick 105

I. A wort of 12° Balling is prepared (say 2500 gallons).

II. A part (650 gallons) of this wort is diluted in the fermenter with water to 1° Balling. That is, water is added until the volume is 12 times as great i.e. 7800 gals. These selected volumes obey the rule as to mean balling — thus

7800 × 1 = 7800
1850 × 12 = 22200
9650
30,000
9650 | 30000 (3,1

to the diluted wort (II).

III. Seed yeast is added, aeration started, and the feed of concentrated wort (12° - 1850 gallons left) into the dilute solution is started and maintained. The final volume will be 9650 gallons.

IV. yeast is harvested.

PLAINTIFF'S EXHIBIT P-20.

Sheet Describing Experiment Which Dr. Schultz Carried Out to Replace Portion of Molasses Mash by Alcohol, and Etc.

Fermentation Laboratory

Dr. Frey

— Molasses check and molasses plus alcohol run for yields of molasses in the presence of alcohol.

33% Cane
67% Beet molasses
+.75% Ammonium acid phosphate
+.9% Sodium bicarbonate

Hrs.	% Molasses 17 at start	300 gms. molasses	225 gms. molasses + 29 gms. C_2H_5OH equiv. to 38 gms. 95%
1	6	pH	pH
2	8	about	about
3	10	4.5	4.5
4	12		
5	14		
6	15		
7	13		
7½	5		
8	—		
Total NH_3 equi.		28.5	31.0
Protein on Solids		50.7	53.2
Yield 26% Solids		104.3	104.4
Bake		92, 66, 76	91, 61, 63

The above experiment where the zulauf finishes one-half hour from the end of the growing period shows that the same yield was obtained from 29 gms. C_2H_5OH as 75 grams molasses.

A. Schultz

PLAINTIFF'S EXHIBIT P-21.

Sheet Explaining Tests by Dr. Lamb.

NEUTRALIZING POWER OF AMMONIUM LACTATE.

1. Prepared a wort, corresponding to that in the propagating vat of M-177 at the end of the 6th hour, without souring and without yeast.

2. To one portion of this wort I added the amount of lactic acid corresponding to the initial acidities. The calculated amount of phosphoric acid which would be inherent from the ammonium phosphate was then added. Finally the amount of sulphuric acid corresponding to the added ammonium sulphate was added. The concentration of the hydrogen ion was measured by means of the quinhydron electrode after each of the above additions.

3. This experiment was then repeated with an initial addition of ammonium lactate corresponding to the amount of ammonium lactate that was added in the vat of M-177 at the end of the 6th hour.
At the end of the 6th hour we have 1575# materials in the fermenter in 9850 gallons. This calculates to 6.1 grams in 318 c.c.
At this place also we have 3.3 pounds of lactic acid equivalent to 2.8 c.c. of .05 N; 85# ammonium acid phosphate equivalent to 2.7 c.c. 10% phosphoric acid and finally 47.7# ammonium sulphate equivalent to 13.6 c.c. 0.2 N $H_2S\ O_4$.
The ammonium lactate in the wort was 2%. This was made by adding theoretical quantities of ammonia and lactic acid.

The table below gives the corresponding PH's.

	Without Ammonium Lactate	With Amm. Lac.
6.1 grs. mash materials in 318 c.c.	4.92	5.07
+ 2.8 c.c. .05 N lactic	4.81	4.94
+ 2.7 c.c. Phosphoric (10%)	3.50	3.70
2 c.c. H_2SO_4 (.2N)	3.34	3.55
4 c.c.	3.21	3.47
6 c.c.	3.12	3.36
8 c.c.	3.00	3.25
10 c.c.	2.90	3.16
12 c.c.	2.80	3.05
13.6 c.c.	2.73	3.00
16.0 c.c.		2.87
18.0 c.c.		2.80
20.0 c.c.		2.70

PLAINTIFF'S EXHIBIT P-22.
Table Showing Prior Art Disclosure.

	cited in Patent Office or by defendant in former litigation	amount of inorganic nitrogen from ammonium salts which might release harmful acid during yeast manufacture	any stated or remedied acidity problem from inorganic ammonium salts during yeast manufacture	any substantial use of neutralizing aqua ammonia as source of assimilable nitrogen during yeast manufacture	Any disclosure like defendant's process (Plaintiff's Exhibits 13, 14, 15) in respect of (a) substantial use of inorganic salts as assimilable nitrogen source in yeast manufacture	Any disclosure like defendant's process (Plaintiff's Exhibits 13, 14, 15) in respect of (b) consequent acidity problem, and use of neutralizing aqua ammonia or other anti-acid in yeast manufacture	(c) correlated dilute starting solution and concentrated reserve solution, with regulated feed of latter at rate proportional to yeast propagation without any significant alcohol formation not consumed by yeast before propagation ended	yield of yeast on raw materials on same scale used by plaintiff and defendant
LAVEDAN	too late in date	unstated- low yield shows no significant amounts	unstated- low yield shows no acidity problem	no	no	no	no	about 33% on molasses
POLSKY	yes	negligible	no, because stated chemical composition of salts made no difference	no	no	no	no	asserts 90%
JACQUEMIN	yes	unstated, except says may be omitted without difference in result, therefore insignificant	no	no	no	no	no	seed yeast only, and yield unstated
MOLHANT	yes	unstated - no suggestion of any significant amount	no	no	no	no	no	no yield stated seed yeast and merely acclimatized to acid for making alcohol
ROTH	yes	no suggestion of any significant amount and says equivalent with none	no	no	no	no	no	preparatory treatment only
POLLAK	yes	none	no	yes	no	no	no	preparatory treatment only
FRITSCHE	yes	suggests adding only 1/3 - 1/1x amount of salts used by defendant	no, low yield shows no acidity problem	no	yes	no	no	unstated, except increase of 7 to 12% yeast with much alcohol
HENNEBERG Jour. Soc. Chem. Ind. Pure Products	yes	unstated, and experimental	no	no	unstated, and experimental	not clearly stated even in distilled water; clearly stated none in ordinary water commercially used	no	unstated
Brennar Centralblatt	no	unstated, and experimental	No, says acid harmful to molds, and yeast practice so used acid to prevent infection	no	no, experimental on molds	no	no	molds, but yields not stated
WILFERT PRESSHEFE	no	none	no	no	no	no	no	preparatory

PLAINTIFF'S EXHIBIT P-23.

British Patent No. 778 of 1880 to William Robert Lake.

[Second Edition.]

A.D. 1880, 21*st* FEBRUARY. N° 778.

Manufacture of Yeast.

LETTERS PATENT to William Robert Lake, of the Firm of Haseltine, Lake, and Co., Patent Agents, Southampton Buildings, London, for an Invention of "IMPROVEMENTS IN THE MANUFACTURE OF YEAST." A communication from abroad by Jacques Rainer, of Vienna, Austria, Doctor of Chemistry.

PROVISIONAL SPECIFICATION left by the said William Robert Lake at the Office of the Commissioners of Patents on the 21st February 1880.

WILLIAM ROBERT LAKE, of the Firm of Haseltine, Lake, and Co., Patent Agents, Southampton Buildings, London. "IMPROVEMENTS IN THE MANUFACTURE OF YEAST." [A communication from abroad by Jacques Rainer, of Vienna, Austria, Doctor of Chemistry.]

This Invention relates to the manufacture of yeast without the ordinary alcoholic fermentation and without the ordinary formation of secondary products.

The said improvements consist,—

First. In the employment of vegetable peptones with the addition of small quantities of dextrose, maltose, or other similar hydro-carbons for the purpose of the culture and growth of the cells of yeast.

Secondly. In adding successively peptones and sugar to the comparatively stable nutritious solution used for growing the yeast, and in successively withdrawing the finished yeast produced in the said solution.

Thirdly. In the manufacture of pressed yeast in large quantities without alcoholic fermentation and without production of alcohol or vinegar.

Fourthly. In the admission of ozonized air or ozonized oxygen for the purpose of accelerating and intensifying the growth of the yeast.

According to the present improvements the process of manufacturing the yeast is carried into practice in the following manner, that is to say:—

The vegetable albuminous matters obtained from maize or other grain legumen, or from waste products, such as bran, the radicles of malt, spent malt, gluten, and other similar products are treated with water containing a small quantity of an alkali or of a mineral acid, and the extract is peptonised by the addition of diastase in the presence of diluted acid. In the radicles of malt especially part of the albuminous matters are already peptonised by the previous growing of the barley,

and their extract already contains some diastase. According to the quantity of peptones contained in the fluid a quantity of sugar, dextrose, maltose, or of their equivalents is added in the proportion of about one-half of the weight of dry peptones present. This addition ought to be about one half per cent. of the total quantity of the fluid, and serves solely for the purpose of yielding the material for the formation of the structure of the cells of yeast. A small quantity of beer yeast or pressed yeast is also added to start the growth, and atmospheric air or ozone is conducted into the fluid to accelerate the growth and impede fermentation. When after some hours the sugar already added has been consumed by the growth of the yeast, a further portion of about from one-tenth to one-fourth per cent. is again added, and in a similar manner the peptones already consumed are replaced by gradual and successive addition of further small quantities of peptones.

The yeast produced may be likewise successively and gradually removed by skimming it off or by allowing it to settle.

The purification and pressing of the yeast takes place in the usual manner.

SPECIFICATION in pursuance of the conditions of the Letters Patent filed by the said William Robert Lake in the Great Seal Patent Office on the 21st August 1880.

WILLIAM ROBERT LAKE, of the Firm of Haseltine, Lake, & Co., Patent Agents, Southampton Buildings, London. "IMPROVEMENTS IN THE MANUFACTURE OF YEAST." A communication from abroad by Jacques Rainer, of Vienna, Austria, Doctor of Chemistry.

This Invention relates to the manufacture of yeast without the ordinary alcoholic fermentation, and without the ordinary formation of subsidiary products.

The said improvements consist,—

Firstly. In the employment of vegetable peptones with the addition of slight quantities of dextrose, maltose, or other similar hydrocarbons for the purpose of the culture and growth of the cells of yeast.

Secondly. In adding successively peptones and sugar to the comparatively stable nutritious solution used for growing the yeast, and successively withdrawing the finished yeast produced in the same.

Thirdly, In a process or method of manufacturing compressed yeast in large quantities without alcoholic fermentation, and without any subsidiary production of alcohol or vinegar.

Fourthly. In the admission of ozonised air or ozonised oxygen for the purpose of acclerating and intensifying the growth of the yeast.

According to the present improvements the process of manufacturing the yeast may be carried into practice in the following manner, that is to say :—

The vegetable albuminous matters obtained from maize or other grain or legumen, or from waste products, such as bran, the radicles of malt, spent malt, gluten, and other similar products are treated with water containing a small quantity of an alkali or of a mineral acid, and the extract is peptonised by the addition of diastase in the presence of diluted acid. In the radicles of malt especially part of the albuminous matters is already peptonized, and their extract already contains some diastase. According to the quantity of peptone contained in the fluid sugar, dextrose, maltose, or their equivalent is added in the proportion of about one half of the weight of dry peptones present. This addition ought to be about one half per cent. of the total quantity of the fluid, and serves solely for yielding the material for the formation of the structure of the cells of yeast. A small quantity of beer-yeast or pressed yeast is also added to start the growth, and atmospheric air or ozone is conducted into the fluid to accelerate such growth. When after some hours the sugar already added has been consumed by the growth of the yeast, a further quantity of about one tenth to one fourth per cent. is again added, and in a similar manner the peptones already consumed are replaced by the gradual and successive addition of further small quantities.

The yeast produced may be successively and gradually removed by skimming or by allowing it to settle. The purification and pressing of the yeast take place in the usual manner.

The process of manufacturing the compressed yeast commercially is as follows :—

The vegetable albuminous substances in the corn cereals or other vegetables, or such refuse of industrial establishments as bran cornings, malt residuum, gluten and the like are extracted with the aid of from 15 to 20 parts by measure of water, made slightly alkaline. They are then either peptonised by adding an excess of lactic acid (about 4 per cent.) or mineral acids (about $\frac{1}{4}$ per cent. of phosphoric acid, or about $\frac{4}{10}$ per cent. of either sulphuric acid or hydrochloric acid) at a temperature of from 85 to 100 degrees Fahrenheit, or they are at once macerated in dilute solutions of the above acids and simultaneously converted into peptone.

Lake's Improvements in the Manufacture of Yeast.

A portion of the albuminous substances (from 5 to 10 per cent. of the total weight) in the dried cornings will be already transformed into peptone by the process of vegetation. The albuminous substances in cereals, maize, or other vegetables, and in bran and malt residuum are transformed into peptone by the addition of diastase. In order to effect the conversion it is sufficient to add to one part by weight of the albuminous matter when dry one part by weight of dry malt, or five parts by weight of cornings. As stated the liquid in which the albuminous matter is to be transformed into peptone must contain lactic acid (4 per cent.), phosphoric acid (as much as $^1/_4$ per cent.), sulphuric acid or hydrochloric acid (about $^3/_4$ per cent.), because the presence of an acid is absolutely necessary in the process of converting these substances into peptone.

A temperature of about 100 degrees Fahrenheit is the most suitable for the conversion of said substances into peptone, and a period of from 18 to 20 hours will be sufficient to effect it. It may however be also carried out at lower temperatures during a correspondingly longer time. In working cornings it is superfluous to add malt, because the diastase contained in the cornings is more than sufficient for the process of conversion into peptone. Therefore it is only necessary in this case to use one of the above named acids in the proportions given.

The mixture of the cornings with water may be effected by hand or by means of a stirring apparatus actuated by any suitable machinery. In mashing malt or cereals, that is to say, in preparing the necessary maltose, dextrose, or the like, I use the apparatus ordinarily employed for such process, care being taken to maintain the temperature and other conditions necessary for proper concentration, as described and recommended in modern technical journals especially in Professor Dr. Max Maerker's "Handbuch der Spiritus Fabrication" (Handbook of the Manufacture of Spirits).

The slimy pectates contained in the cornings as well as in other materials are dissolved by the combination of diastase and acids.

When the preparation of pure peptone is acquired the pectates may be separated by an endosmotic apparatus or dialysator in such a manner that the peptone is dialysed through proper membranes in water, while the gelatinous pectates remain as a residuum.

The acids are neutralized by means of soda, or by saturating the liquid with basic phosphate of lime in the manner hereinafter described.

The prepared peptone liquid, with or without a percentage of sugar, may be shipped as a saleable article, or it may be delivered in a dry state, or as a syrup or extract obtained by boiling the liquid down in a water bath, by steam, or preferably in a vacuum.

The liquid containing peptone may be separated from solid matter (hydrocarbons vegetable fibre, or the like) by simple extraction, maceration, or pressure, or by centrifugal action, or it may be carefully cleaned by filtration or settling. It is advisable however before cleaning by filtering or settling to neutralize any acid present by means of soda, or to saturate the liquid with basic phosphate of lime, the latter being preferable because the phosphoric acid required by the yeast is thus abundantly furnished to it.

In order to start the growth of the yeast gelatinized starch is added after being transformed in the usual way into dextrose by boiling with an addition of mineral acids. In the place of starch thus prepared an addition may be made of maltose, molasses, or sugar mixed with beer yeast or compressed yeast. The amount thus added should correspond to the percentage of peptone in the liquid, being one half of the dry weight of the peptone. The said hydro carbons should however always be only from $^1/_2$ to 1 per cent. of the weight of the entire liquid, and should even then serve exclusively for the formation of the walls of the cells of the yeast.

The vegetation of the yeast will take place most satisfactorily at temperatures varying from 57 to 64 degrees Fahrenheit. At a higher temperature losses may easily occur by reason of the partial conversion of the sugar used into coagulated lactic acid or into alcoholic fermentation, instead of furnishing the yeast with

substance for cells. The yeast is either propagated, as is the custom in Holland, in shallow vessels in which the depth of liquid is about five inches, so that a sufficient quantity of atmospheric air has access thereto; or it may be better and more safely effected in vats made of wood, glass, masonry, cement, or other suitable material, into which atmospheric air is conducted by suitable distributors through tubes or pipes by means of blowers or compressors in a fine state of division.

Instead of atmospheric air alone it is more advantageous to use air containing an increased amount of ozone or of oxygen partially converted into ozone. The latter is prepared by successively adding hydrogen dioxide to the propagating liquid. The percentage of ozone in the air is increased by means of phosphorus, or by causing it to pass through a closed vessel in which permanganate of potassa is mixed with the necessary quantity of mineral acid. The air thus enriched with ozone is thus allowed to pass into the propagating liquid.

The growth of the yeast will be completed within from 6 to 8 hours after every sufficient addition of dextrose, maltose, or other material, according to the density of the propagating liquid used, the temperature of the latter, and the amount of the ozone in the air. The percentage of peptone of the mass may amount to from 1 to 2 per cent. or more of its weight, while only from half to one per cent. of dextrose or other hydro carbons is added at each time, in order to be sure to prevent the formation of coagulated lactic acid or alcoholic fermentation, and the losses attendant upon it for my process.

When the entire amount or bulk of the dextrose or other sugar added to promote the growth of the yeast has been consumed after from 6 to 8 hours, a further quantity thereof, say, from $^1/_{20}$ to $^1/_{10}$ per cent. is added. The peptone may also, after having been consumed, be added in portions, or may be allowed to flow in gradually and continuously. The same propagating liquid made by successive replacement of the matter consumed remains in use for weeks or months, unless it is rendered impure by other substances, or by subsiding fermentation, and thus made unfit for further use.

In the same manner as the materials necessary for the propagation of the yeast are added the yeast produced may be successively withdrawn, and only the yeast suspended in the liquid remains behind as the germ for the ferments of alcohol to be afterwards formed.

The yeast is obtained either by skimming it from the surface of the liquid or by separating it from the propagating liquid by filtration, or finally by gathering it after tapping the vats from the bottom upon which it is deposited in a compact layer.

In working on a large scale it is advisable to place the vats in terraced batteries in order to effect the transfer of the propagating liquid from one vessel to the other with facility.

In order to produce yeast as free as possible from subsidiary ferments the propagating liquid may be prepared in a more dilute state, that is to say, with a percentage of peptone of only from $^3/_4$ to 1 per cent. The hydrocarbons (dextrose, maltose, or the like) may also be added in smaller quantities for example, as a first dose about $^1/_2$ per cent., and then every 3 hours about $^1/_{20}$ per cent.

The greater part of the peptone present will then be transformed into yeast in from 12 to 15 hours, a sufficient supply of pure air, if necessary conducted through sulphuric acid or oxygen containing ozone, being provided, and the entire process being carried on at a temperature varying from 54 to 63 degrees Fahrenheit. The whole liquid is then cooled by a suitable apparatus, or by adding cold water or ice; the best temperature being from 45 to 50 degrees Fahrenheit. Within from 36 to 48 hours the yeast obtained will settle on the bottom of the vat. The propagating liquid may be allowed to flow away. The yeast obtained by this improved process is purified and condensed in the usual manner, but in order to increase its durability phosphate of lime amounting to from 4 to 5 per cent. of the total weight of the yeast to be made may be added before compressing it.

Experience has shown that from 250 to 300 parts of pure and active compressed

yeast may be obtained from 100 parts of pure peptone. For the growth of the said quantity of yeast only about 200 parts of dextrose or sugar are required.

Having thus fully described the said Invention as communicated to me by my foreign correspondent and the manner of performing the same, I wish it understood that I claim,—

First. The process of cultivating the cells of yeast from vegetable peptone by the addition of dextrose or similar hydrocarbons, substantially as specified.

Second. In making yeast, the process comprising the successive additions of peptone and hydro-carbons to the propagating liquid, together with the successive removals of the yeast produced, all substantially in the manner and in the proportions specified.

Third. The process or method herein described of manufacturing compressed yeast without alcoholic fermentation, and without producing alcohol or vinegar, as above set forth.

Fourth. In making yeast the application of currents of ozone to the propagating liquid for the purpose of accelerating the growth of the yeast, and of increasing the intensity of its development, substantially as specified.

In witness whereof, I, the said William Robert Lake, have hereunto set my hand and seal, this Twenty-first day of August, in the year of our Lord One thousand eight hundred and eighty.

WM. ROBT. LAKE. (L.S.)

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.
[G. 9781—25—3/1907.]

PLAINTIFF'S EXHIBIT P-24.

[Translation by George C. O. Haas, Ph.D., New York]

Delbruck "Illustriertes Brennerei-Lexikon"

(Pages 347-349)

Article "Hefefabrikation"

Yeast-manufacture is the production of bakers' yeast on a factory scale in yeast factories. In the present state of the art it is generally carried out, in its practical execution, according to two processes, which in turn manifest differences within themselves in method of operation. In the case of both processes a mash that is rich in yeast nutrients is first produced from raw materials, especially grain, that contain starch or sugar and are rich in proteins.* In the case of one of the two processes, the so-called old process (also called the Vienna or skimming process) the yeast is then cultivated directly in this mash containing grains and is extracted from it, after the development has been completed, by decanting or skimming off from the surface. The alcohol that is produced in the course of the manufacturing process is of good quality and is worked up into beverage spirits. As by-product in the distilling of the mash there results a valuable hot residual liquid. On the basis of the observations and experiences gained in the old process with regard to the production of commercial yeast that is capable of being shipped, a new method of production of compressed yeast, which is called air yeast-manufacture or wort yeast-manufacture, has developed in the course of the last 25 years from the scientific discovery that the multiplication of yeast is exceedingly stimulated by introduction of air and that by means of the blowing-in

* [Translator's note.—The word *zuckerhaliigen* is a misprint for *zuckerhaltigen*, and *eiweissweichen* for *eiweissreichen*.]

of air into a wort pitched with yeast the yield of yeast from the same quantity of raw material, in comparison with the former yield, can be increased to more than three times as much. In this process the mash is not pitched directly with yeast, but a wort is extracted from it by means of clarification or by filtering in filter presses, and this wort is set in fermentation with yeast, in which connection large quantities of air are supplied to the fermenting yeast during the entire time of its development by blowing it into the wort. After the development has been completed, the yeast is extracted from the wort by allowing it to settle on flat settling pans or by centrifugalizing with the use of separators. The wort that has been freed from yeast is subjected to distillation, in which process the alcohol is extracted from it. In consequence of the abundant introduction of air into the fermenting wort, the alcohol is greatly contaminated by aldehyde and other admixtures, so that in most cases it can only be employed for technical purposes and be utilized in a less valuable manner than the alcohol from the old process. The yield of alcohol in the aeration process is also materially less than in the latter. Because of its great dilution and its low content of digestible nutritive substances the distilled wort has only a slight feed value. It is therefore employed, if at all, only as a pouring-over liquid at the mixing of the feed or passes into the waste liquors of the plant. A valuable agricultural by-product in connection with the wort process is constituted by the grains that remain behind at the clarifying or filtering of the mash. Computed on the initial material, they possess about half the value of the residual liquid in the old process.

The advantages of the aeration process in comparison with the old process lie primarily in the unequally greater yield of yeast, the lower cost of production, the

simpler mode of procedure, and the greater uniformity and certainty of operation. The manufacture, which has in recent years been extended to large-scale operation in almost all air-yeast factories, turns out in Germany at the present time about 95 per cent of the entire production of yeast. The old process is still adhered to in the smaller and medium-sized yeast distilleries, primarily agricultural ones, in consideration of the superior quality of spirituous liquors and the advantages of the residual liquid, which is rich in nutritious substances, as an excellent hot feed for fattening and milk-production.

I. In the "old process" the principal raw materials are: kiln-dried malt, rye, barley, maize, clarified residual liquid, and water, sometimes also potatoes and green malt. The grain is first subjected to a good dry cleaning and is then thoroughly comminuted in mills, roller mills, or roller crushers. In the preparation of the mash, in which process 125-150 kilograms of total grain are ordinarily used for 1000 liters of mash and the malt constitutes about 25-30 per cent, the principles that generally obtain for the dissolving, peptonizing, making up into paste, and saccharification are followed (see Mash). As mashing temperatures there are employed the temperatures between 45 and 62° C. which are the most favorable for the peptonizing and saccharification, in which connection those raw materials which require a higher mashing temperature in accordance with the nature of their starch (maize, dried potatoes, barley) are previously hydrolyzed and made into a paste by boiling or else by the application of slight pressure (1 to 1½ atmospheres). After a saccharification time of 2 to 3 hours at 60-62° C. the mash is cooled off. In order to promote the dissolving and peptonizing of the proteins, it receives, during the cooling, an addition of several liters of mash that is acid

with lactic acid or of a fairly large part of the clarified residual liquid. Between 50 and 54° C. the cooling is discontinued, and the mash remains standing at this temperature for about 1 to 2 hours. Thereupon there is effected a rapid cooling down to the pitching temperature, which is to be chosen, according to the circumstances, between 21 and 24° C. For pitching there serves the yeast that has been cultivated in a special mash (cf. Yeast Mash) or compressed yeast, sometimes also both of these (cf. Pitching and Pitching Yeast). The mash is mixed in the fermenting vat with the rest of the clarified residual liquid and receives in connection therewith an addition of sulfuric acid. After its completion the mash has a sugar content of 8 to 12° Balling and an acidity of between 0.3 and 0.4 (in working with residual liquid, 0.5 to 0.6). During the fermentation the yeast rises upward in the mash (rising tendency) with the aid of the carbonic acid developed and gradually collects upon the surface of the mash in a blanket of foam about 30 centimeters high. In 12 to 13 hours the yeast foam has attained its greatest height, and it now remains stationary, since the development of carbonic acid subsides. After the initially lighter bubbles of a glassy appearance have thereupon within 2 to 3 hours become milkily cloudy and less readily movable, and the yeast cells larger and more uniform, the yeast is ready for the skimming-off. The attenuation of the mash has at this stage progressed as far as 3 to 4° Balling. In the case of normal vats the skimming-off of the yeast is concluded after 5 to 6 hours. The yeast that is removed is at once mixed with cold water and thereupon freed by straining (cf. Yeast Strainer) from the grain and mash particles still adhering to it and then passed into flat washing and settling vats. After the water has been changed two to three times, the thickly pasty yeast that has settled

down is freed from the still adherent water by pressing in sacks or filter presses (cf. Yeast Press) and brought to the consistency requisite for shipment. The yeast that has been pressed dry has a dry substance of 25 to 27 per cent. For sale at retail the yeast is shaped into measured pound pieces (cf. Yeast Form and Dividing Machine); for wholesale shipment it is customary to pack it in tightly rammed and pressed bags (see Yeast Bag Press).

The yields attained in the skimming process are widely different in the individual factories according to the installation, management of the plant, and mode of operation. On an average 12 to 13 kilograms of yeast and 14 to 15 liters of alcohol are obtained from 100 kilograms of grain that are doughed in.

II. In the air-yeast process there are used as raw materials especially malt (mostly green malt), maize, and malt sprouts. Sometimes potatoes, rye, raw barley, molasses, and sugar-beet juice also constitute the principal component of the mash material. In addition to the content of starch and sugar, a high protein content of the raw materials is particularly necessary. The percentage composition thereof is subject to not inconsiderable fluctuations according to the price of raw materials, the purpose of the manufacturing process, and the installation available for the treatment in the individual plants. On an average one chooses 40 to 60 per cent of maize, 30 to 40 per cent of barley in the form of green malt, and 10 to 25 per cent of malt sprouts, in which connection the maize may also be replaced by other materials containing starch, such as potatoes, raw barley, or manioc. For the preparation of the mash the raw materials are previously comminuted in crushers or wet mills and mixed in the fore-mashing vat with slightly acidified water of 40 to 45° C., and the mash liquid thereupon heated with the

steamed or boiled portion of the raw materials (maize, potatoes, raw grain) with vigorous mashing and with gradual increase of the temperature as far as 50° C. After standing for 1 to 2 hours there follows the scalding with steam to the saccharification temperature of 62 to 63° C., at which the mash now remains standing for about 2 to 3 hours for saccharification. The clarifying material (malt sprouts, oat husks, chaff) may be added before the mashing or after the saccharification. After the saccharification is completed, the mash, which as a rule has a concentration of 10 to 12° Balling, is subjected to a peptonization for 12 to 15 hours, with the employment of pure lactic acid bacteria, and is thereupon passed through filter presses or clarified for extraction of the wort. The solid constituents of the mash (grains) are extracted with hot water (afterflushing) until all the soluble extract substances are transferred into the wort. The latter, after adequate cooling in the fermenting vat, is set for fermentation with about 4 to 6 per cent of pressed-dry yeast (computed on the basis of 100 kilograms of raw material) at favorable growth temperatures, 22-25° C., and at the same time vigorously aerated during the entire time of the fermentation, in order to promote the growth of the yeast. The fermentation and development of the yeast are completed in 8 to 10 hours. Toward the end of the fermentation the quantity of air is diminished. The yeast is extracted from the fermented wort by separating (cf. Separator) or by allowing it to settle upon flat settling pans, and is pressed dry in filter presses to the consistency requisite for shipment. The alcohol is extracted by distillation from the wort that has been freed from yeast. Under normal circumstances 28 to 30 kilograms of yeast and 18 to 20 liters of alcohol are obtained from 100 kilograms of doughing-in material. By means of great dilution of the

wort, increased aeration at a lower temperature, and increase of the proteins the yeast yield may be further augmented, while the alcohol yield then declines. (Lg.)

Original of Pages 347 to 349 of Delbrück "Illustriertes Brennerei-Lexikon."

(Physical Exhibit.)

PLAINTIFF'S EXHIBIT P-25.

United States Patent No. 2,008,584 to Harold L. King, Dated July 16, 1935.

Patented July 16, 1935

2,008,584

UNITED STATES PATENT OFFICE

2,008,584

PROCESS OF TREATING DISTILLERY SLOP

Harold L. King, Bloomfield, N. J., assignor to National Grain Yeast Corporation, Belleville, N. J., a corporation of New Jersey

No Drawing. Application February 4, 1931, Serial No. 513,460

7 Claims. (Cl. 195—29)

My invention is a process of treating waste distillery slop, to render the same available as a constituent of the nutrient medium for the propagation of commercial compressed yeast, and a nutrient medium for the propagation of commercial compressed yeast.

Distillery slop, obtained from the alcoholic fermentation of beet molasses, or blackstrap molasses, has long been regarded as a waste product. This waste product, in the operation of large plants, presents serious difficulties in connection with its disposal. Due to its characteristic odor, it is frequently impossible to discharge the same into the ordinary sewage system of a town or city, and separate sewage systems have been built for its disposal, at a large cost. Attempts have been made to utilize this product in the production of fertilizer, by incinerating the same for obtaining the potassium content, but such method is not economical or profitable. As far as I am aware, no successful profitable method has been devised for utilizing this waste distillery slop.

I have discovered that the waste distillery slop, when properly treated in accordance with my method, may be successfully used as a constituent of a nutrient medium for the propagation of yeast.

When a regular molasses mash of high gravity (22° to 25° Balling) is fermented for the production of commercial alcohol, the yeast present functions chiefly to split up the inverted sugars into ethyl alcohol and carbon dioxide gas. Due to the almost complete exclusion of oxygen, especially after fermentation has set in vigorously, there is only a very slight propagation of yeast cells and, consequently, very little assimulation by the yeast cells, of the large amount of nitrogen matter and dissolved mineral substances present in the mash. This is due to the fact that yeast cannot assimilate the substances necessary for growth and rapid reproduction, except in the presence of large amounts of oxygen. In the absence of oxygen, yeast functions in an entirely different manner, serving as a true agent of fermentation, with a very small degree of cell reproduction.

It therefore, follows that at the end of the fermentation process, and after the fermentable sugars have all been transformed into alcohol and carbonic acid gas, a very large percentage of the original nitrogen matter and mineral salts still remain in the residue or slop, and this slop, if properly treated, is capable of forming a constituent of a nutrient medium for the propagation of yeast.

However, the contents of this original slop and especially the nitrogenous matter is of a more or less complex composition and not easily available for yeast growth, without preliminary treatment to reduce the same to a mass having constituents of a less complex composition.

The slop is to be used in conjunction with a yeast mash formula made up of beet or cane molasses, malt, and malt sprouts.

By actual tests, from a given amount of raw materials, (malt, malt sprouts and molasses) used in conjunction with slop, a quantity of final compressed yeast was obtained which was greater by approximately 20% than the amount which was obtained from the same given amount of raw materials without the use of slop.

The introduction of the slop into the regular mash formula of grain and molasses is accomplished as follows: The total amount of malt to be used is mashed and converted in water, by the usual method, using only a small amount of water, or the minimum amount which can be employed to produce the condition necessary for complete conversion of the malt mash. After conversion is completed, this mash is cooled to a proper temperature of from 128° to 130° F. and a pure culture of lactic acid bacteria is introduced into the mash, the amount of the bacteria to be added, depending to some extent upon the total quantity of raw materials to be soured, as is well known in the art. The mash is held at this temperature of 128° to 130° F., for several hours, (from 3 to 6 hours) until the action of the bacteria has gotten well started and lactic acid is being formed. At this point, the mash is very thick and heavy as only enough water has been added to allow the necessary reactions for complete conversion of the starch and protein of the mash.

The next step in the process is to introduce the waste slop into the souring malt mash, and as dilution proceeds, malt sprouts are gradually added until all of the sprouts have been introduced. As the waste slop is usually added hot, just as it is discharged from the beer still, the mash must be continually cooled to maintain the same at the proper souring temperature of from 128° to 130° F.

About one-half of the total amount of slop to be used in the complete mash, is added to the malt and sprout mash at this point, and the whole mixture is allowed to sour for the balance of the first 24 hours, with the occasional addition of aqua ammonia as the acidification proceeds. The action of the bacteria becomes greatly retarded when the maximum point of acidity is reached, this point, shown by tests, to be that which requires between 40 to 60 c. c. of $\frac{1}{10}$ normal alkali solution to neutralize 40 c. c. of the mash. Therefore, the ammonia is added to keep this acid level considerably below this maximum point, as, for example, between the limits of acidity requiring from 10 to 20 c. c. of the $\frac{1}{10}$ normal alkali to neutralize 40 c. c. of the mash.

In the meantime, in another vat, the beet molasses to be used is treated separately. Instead of using water to dilute the heavy beet molasses, I use the remaining one-half part of the waste slop. The resultant mixture is rendered slightly acid by the addition of sulphuric acid and heated by direct contact with steam to almost a boiling temperature, between 90° to 95° C. Instead of using beet molasses, I may use cane molasses, which would be clarified by the method well known in the distillery art.

The phosphate present in the added slop will produce a precipitation of the albuminous matter. The mash is allowed to set for a suitable length of time, such as over night, so that the precipitates will settle to the bottom of the mixture and the mixture is clarified.

After the precipitated matter has thus settled to the bottom, the mixture is clear. The clear liquid is drawn off, leaving the solids at the bottom.

The clear liquid thus produced is now introduced into the souring grain mash, previously prepared, and fresh culture of lactic acid bacteria is now introduced into the resultant mash, which is allowed to continue to sour for 24 hours more, with the continued addition of aqua ammonia, at intervals, as acidity develops, to keep the acid level between the limits of 10 to 20 c. c. of the $\frac{1}{10}$ normal alkali solution required to neutralize 40 c. c. of the mash. While it is preferred to use aqua ammonia as the alkaline neutralizing agent, yet I may employ other alkaline neutralizing agents, such as lime (CaO) or like substances, with some degree of success. When the souring has proceeded for a sufficient length of time to produce the desired changes in the composition of the mash, ordinarily from 36 to 48 hours, the addition of the alkaline neutralizing agent is discontinued and the amount of acidity required in the completed mash is allowed to accumulate. The final degree of acidity must necessarily depend upon the particular process of yeast cultivation to be employed from this point on. The acidity is determined by the usual method of titration with $\frac{1}{10}$ normal alkali solution on a measured quantity (40 c. c.) of the mash, using specially prepared litmus paper as indicator.

The resultant mash is now sterilized and filtered for separation of the soluble extracted matter from the insoluble grain residues, and the liquid mash is next filter-pressed for more complete clarification by the removal of all finely divided insoluble matter, which is precipitated from the waste slop.

Considering malt, sprouts, and molasses as constituting 100 percent of the regular mash formula, I, preferably, employ 20 parts by weight of malt, 20 parts by weight of sprouts, and 60 parts by weight of molasses, although the proportions may be widely varied. The slop is added in each instance, as a substitute for water, to dilute the mash to a desired gravity. The final mash has a gravity of from 18° to 24° B. This mash contains grain constituents such as the malt and sprouts, these constituents containing easily assimilable nitrogen in the form of amino-acids in an amount sufficient to initiate the lactic acid fermentation, or in other words to supply the lactic acid bacteria during the first part of the process.

During the lactic acid fermentation, described in connection with the grain mash, and also in connection with the combined grain mash and beet molasses mash, the complex protein bodies contained in the slop, as well as those present in the regular mash materials, are split up into nitrogen compounds of much more simple composition and rendered more easily assimilable by the yeast cells, as food. One of the most valuable of the simpler forms of organic nitrogen bodies are the so-called amino-acids. The nitrogen of the amino-acids is easily and readily assimilated by yeast. The composition of the above mash, during the prolonged action of the lactic acid bacteria shows an ever increasing quantity of amino-nitrogen, brought about by the continued breaking down of the more complex proteins. It is, therefore, desirable to prolong the action of the lactic acid bacteria, but the bacteria can only function in the presence of a limited amount of acid, and as the acidity increases, the several reactions incidental to its growth and acid-forming properties are necessarily greatly retarded, and finally completely stopped. In order to obtain the prolonged reactions incidental to the maximum growth of the acid bacteria, the degree of acidity is controlled by the addition of the aqua ammonia, directly to the souring mixture, as explained. Acidity tests are made at intervals and measured amounts of aqua ammonia added. By this procedure, the several chemical and biological changes produced by the acid bacteria are greatly prolonged, resulting in a greatly increased amount of nitrogen matter readily available for rapid assimilation by the growing yeast cells. Particular attention is called to the fact that the aqua ammonia is added to the souring mash, at intervals during the souring period, for the purpose of controlling or regulating the acidity, and thereby prolonging the development or growth of acid bacteria, and all reactions incidental to this growth.

The addition of aqua ammonia to the souring mash is also valuable from another standpoint, as it combines directly with the lactic acid, to produce ammonium lactate, which remains dissolved in the extract of the mash, and, furthermore, increases the amount of nitrogen available for yeast food, during the period of yeast cultivation.

The resultant clear wort, although quite highly colored from the use of the slop, contains only soluble coloring matter which can be readily washed away from the finished yeast and a very good quality of yeast of superior fermenting power, and a very good color obtained. To obtain the best color of the finished product, it is necessary to closely regulate the degree of acidity produced throughout the period of yeast propagation. If the proper concentration of H-ions is maintained during the yeast cultivation period and the same controlled so as to be constant, or nearly so, especially during the latter part of this process, a product of very fine color will result.

The control of the acidity during this very important stage of yeast cultivation is made comparatively simple in connection with the use of the materials as prepared by this process, for the following reason. The addition of aqua ammonia during the prolonged period of souring, and the resultant combination of same with the various organic acids formed, result in an accumulation of chemical substances with the so-called Buffer properties. Namely, these substances restrict and hold within desirable limits the formation of free hydrogen ions or ionizable acid radicals which is very important especially during the latter stages of yeast propagation. In this case, it is possible to maintain the pH concentration at practically a constant level with the addition of small quantities of mineral salts and with the entire elimination of any neutralizing agents during the entire period of yeast cultivation.

While I have described a process in which aqua ammonia is added to the mash containing waste slop, during the souring stage, for regulating the acidity, yet, the invention is not necessarily restricted to the treatment of a mash containing the waste slop, as I contemplate treating yeast mash free from the added waste slop, during the souring period, for controlling or regulating the acidity.

It is to be understood that the form of my invention herewith shown and described, is to be taken as a preferred example of the same, and that various changes in the order of the steps of the method may be resorted to, and equivalents employed, without departing from the spirit of my invention or the scope of the subjoined claims.

Having thus described my invention, what I claim is:

1. The herein described process of treating waste distillery slop to render the same available as a constituent of the nutrient medium for the propagation of commercial compressed yeast, comprising combining the slop with a yeast mash including grain constituents containing easily assimilable nitrogen in an amount sufficient to initiate lactic acid fermentation, adding to the mass thus obtained lactic acid bacteria to effect souring of the same, regulating the degree of acidity of the mass by the addition of aqua ammonia so that the lactic acid bacteria are propagated for a prolonged period and the constituents of the slop thereby rendered available as a nutrient for yeast, sterilizing the resultant mass, and filtering for removing foreign solid matter.

2. The herein described process of treating waste distillery slop to render the same available as a constituent of the nutrient medium for the propagation of commercial compressed yeast, comprising combining the slop with a yeast mash including grain constituents containing easily assimilable nitrogen in an amount sufficient to initiate lactic acid fermentation, adding to the mass thus obtained lactic acid bacteria to effect souring of the same, regulating the degree of acidity of the mass by the addition of an alkaline neutralizing agent so that the lactic acid bacteria are propagated for a prolonged period and the contents of the slop thereby rendered available as a nutrient for yeast, sterilizing the resultant mass, and filtering the same for removing foreign solid matter.

3. In the herein described process of treating waste distillery slop to render the same available as a constituent of the nutrient medium for the propagation of commercial compressed yeast, the steps of combining the slop with a yeast mash including grain constituents containing easily assimilable nitrogen in an amount sufficient to initiate lactic acid fermentation, adding to the mass thus obtained lactic acid bacteria to effect souring of the same, and regulating the degree of acidity of the mass by the addition of an alkaline neutralizing agent so that the lactic acid bacteria are propagated for a prolonged period and the contents of the slop thereby rendered available as a nutrient for yeast.

4. The method of producing a nutrient medium for the propagation of commercial compressed yeast, comprising combining waste distillery slop with a yeast mash including grain constituents containing easily assimilable nitrogen in an amount sufficient to initiate lactic acid fermentation adding to the mass lactic acid bacteria to effect a souring of the same, regulating the degree of acidity of the mass by the addition of an alkaline neutralizing agent so that the lactic acid bacteria are propagated for a prolonged period, sterilizing the mash, and filtering the same.

5. The herein described process of treating waste distillery slop to render the same available as a constituent of the nutrient medium for the propagation of commercial compressed yeast, comprising combining a portion of the slop with a grain mash, adding lactic acid bacteria to the resultant mass to effect a souring of the same, controlling the degree of acidity of the mass by adding thereto an alkaline neutralizing agent so that the lactic acid bacteria are propagated for a prolonged period and the constituents of the slop thereby rendered available as a nutrient for yeast, adding a portion of the slop to a molasses and treating the same for producing a clarified liquid mass, combining the clarified liquid mass with the mass first produced for obtaining a resultant liquid mass, adding additional lactic acid bacteria to the resultant mass for effecting a further souring of the same, regulating the degree of acidity of such resultant mass by the addition of an alkaline neutralizing agent so that the lactic acid bacteria are propagated for a prolonged period and the contents of the slop rendered available as a nutrient for yeast, sterilizing the resultant mass, and filtering.

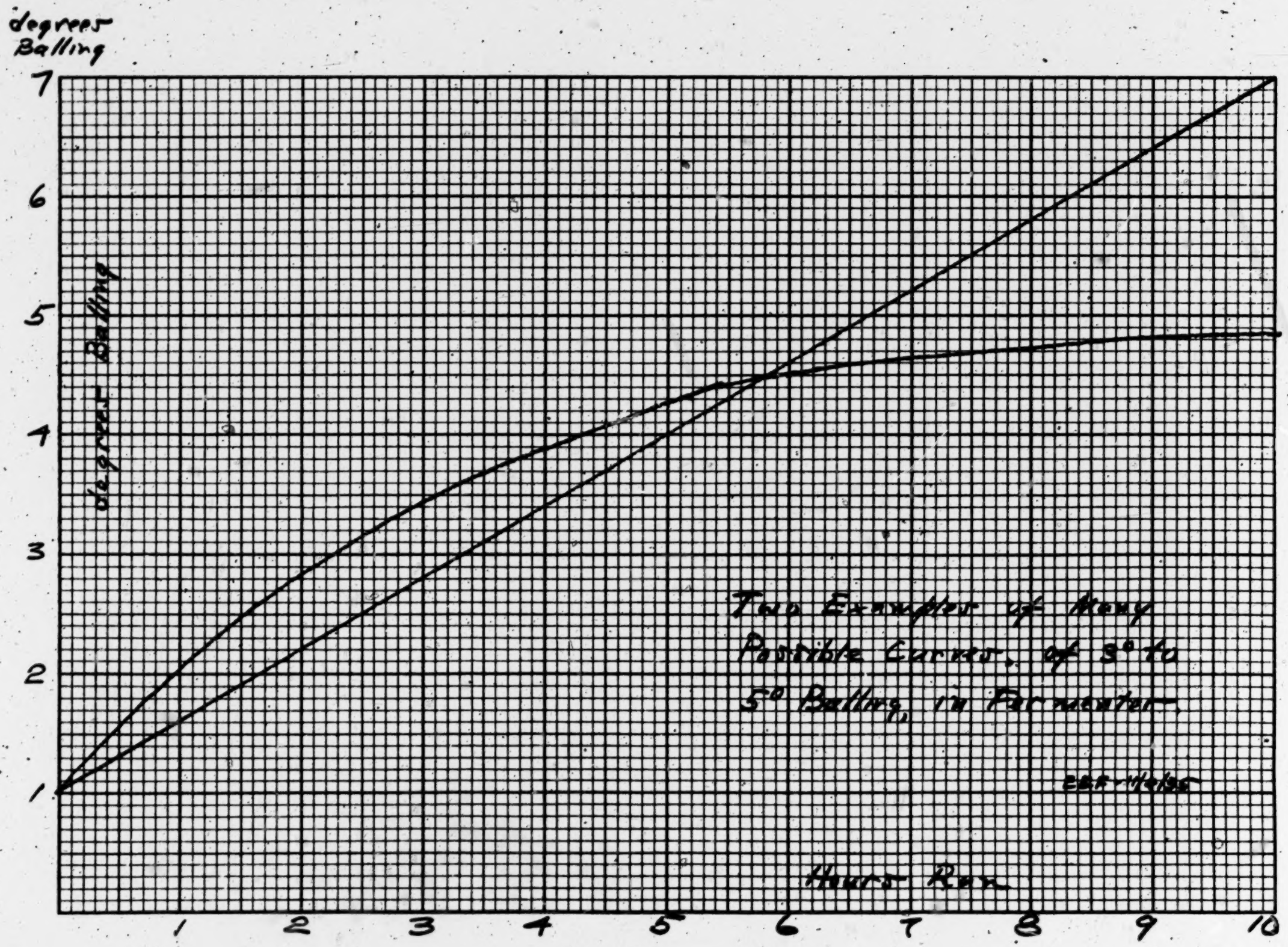
6. The herein described process of treating waste distillery slop to render the same available as a constituent of the nutrient medium for the propagation of commercial compressed yeast, comprising combining a portion of the slop with a grain yeast mash, adding lactic acid bacteria to the resultant mass to effect a souring of the same, controlling the degree of acidity of the mass by adding thereto aqua ammonia so that the lactic acid bacteria are propagated for a prolonged period and the constituents of the slop thereby rendered available as a nutrient for yeast, adding a portion of the slop to beet molasses to dilute the same for providing a second liquid mass, rendering the second liquid mass slightly acid, heating the second liquid mass thus treated and separating the liquid constituent from the solid constituents, combining the liquid constituent of the second mass with the first mass, adding additional lactic acid bacteria to the resultant mass, for effecting a souring of the same, controlling the degree of acidity of the resultant mass by adding thereto aqua ammonia so that the lactic acid bacteria are propagated for a prolonged period and the constituents of the slop thereby rendered available as a nutrient for yeast, sterilizing the resultant mass, and filtering.

7. The herein described process of treating

waste distillery slop to render the same available as a constituent of a nutrient medium for the propagation of commercial compressed yeast, comprising the steps of adding lactic acid bacteria to a grain yeast mash and effecting the propagation of such bacteria within the mash, adding the slop to such mash so that the propagation of the lactic acid bacteria continues and the resultant mass is soured, and regulating the acidity of the mass by the addition thereto of aqua ammonia so that the propagation of the lactic acid bacteria is continued for a prolonged period and the constituents of the slop are rendered available as a nutrient for yeast.

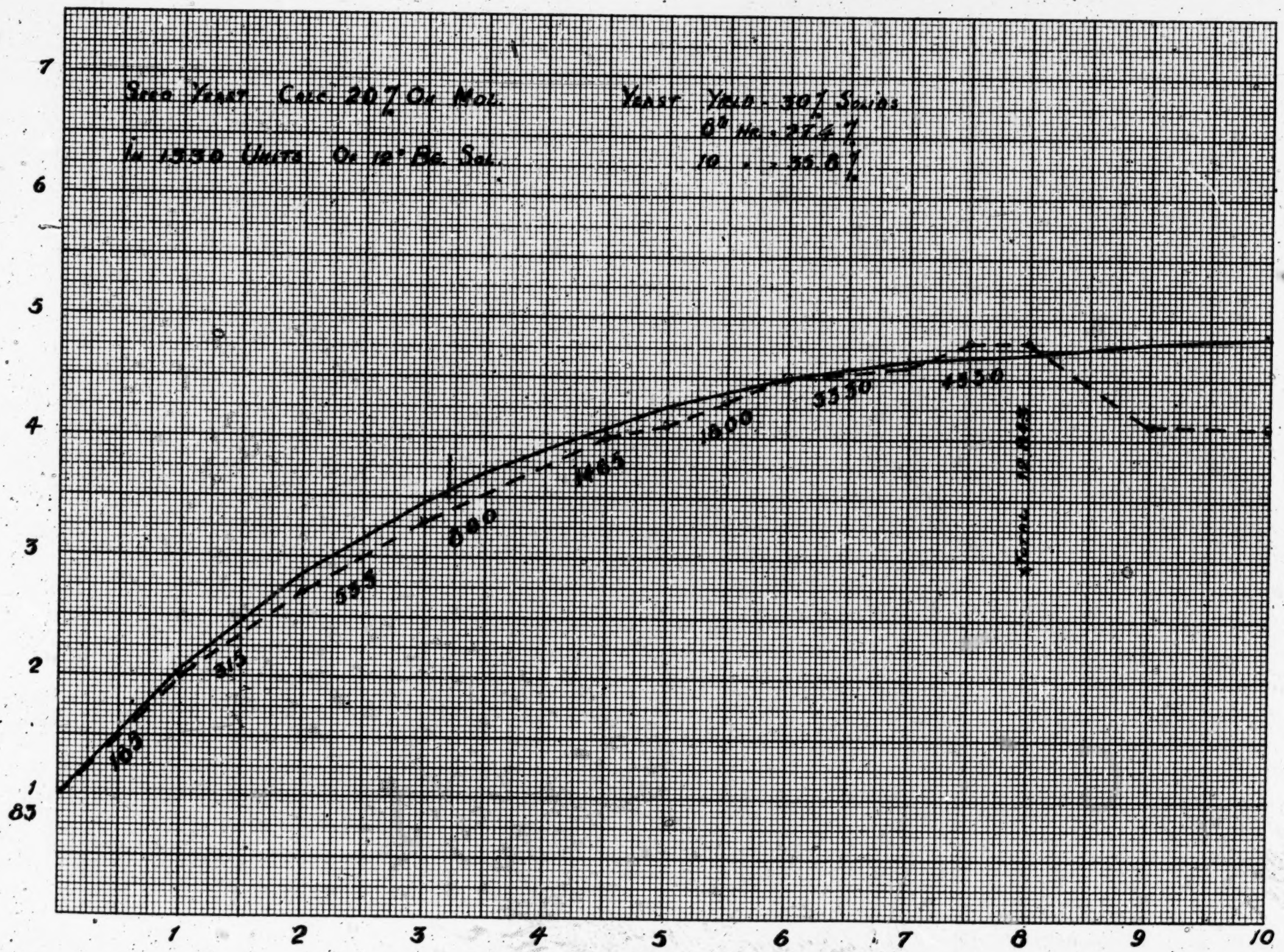
HAROLD L. KING

PLAINTIFF'S EXHIBIT P-26.
Photostat of Free Curves.

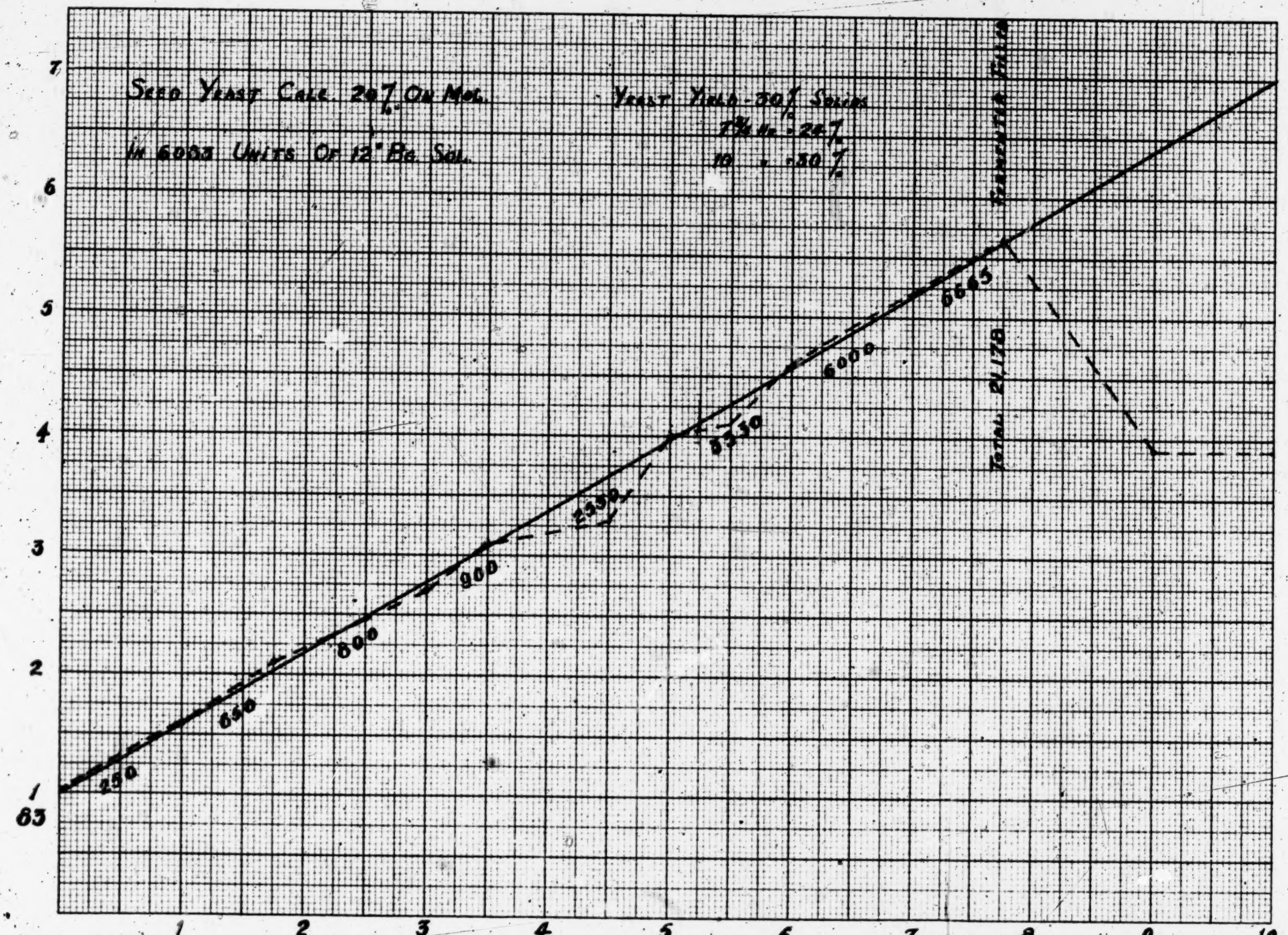


PLAINTIFF'S EXHIBIT P-27.

Graph Giving Arcuate Curve by Dr. Lamb.



PLAINTIFF'S EXHIBIT P-28.
Graph Giving Rectilinear by Dr. Lamb.



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UNITED STATES PATENT OFFICE

LUCIEN LAVEDAN, OF NEW ORLEANS, LOUISIANA.

PROCESS OF MANUFACTURING YEAST.

1,201,062. Specification of Letters Patent. Patented Oct. 10, 1916.

Application filed February 12, 1916. Serial No. 77,896.

To all whom it may concern:

Be it known that I, LUCIEN LAVEDAN, a citizen of the United States, and a resident of New Orleans, in the parish of Orleans and State of Louisiana, have invented certain new and useful Improvements in Processes of Manufacturing Yeast, of which the following is a specification.

My invention relates to improvements in processes of manufacturing yeast, and it consists in the various steps hereinafter enumerated.

The object of my invention is to produce yeast in such a manner that the highest possible yield is effected from a given amount of clear sugared liquid, thereby greatly decreasing the cost of manufacture and making use of certain portions of the raw material which have heretofore been wasted.

A further object of my invention is to provide a process for making yeast which is continuous, and in which there is a continuous aeration of the yeast, thereby supplying to the yeast all the air which is necessary to its maximum development and thus tending to a maximum yield of yeast.

A further object of my invention is to provide a process in which the gathering of the yeast is performed by a continuous mechanical operation.

A further object of my invention is to provide a process in which the separation of the yeast from the associated liquid and the drying of the yeast is accomplished in one operation.

A further object of my invention is to provide a process in which said liquid from which the yeast is separated may again be used in the propagation tank.

Other objects and advantages will appear in the following specification and the novel features of the invention will be particularly pointed out in the appended claims.

My invention is illustrated in the accompanying drawings forming part of this application, these drawings being a diagrammatic view of one form of apparatus for carrying out the invention.

The raw material upon which I operate consists of any clear sugared liquid. This may be a properly prepared and diluted molasses or glucose, or a totally saccharified clear grain must such as is now used in the ordinary process of manufacture.

For purposes of illustration, we will assume that the material to be operated on for the production of yeast is molasses. This is run into a boiler and diluting tank A where the molasses is first diluted, two gallons of water to one of molasses being a good proportion. The diluted molasses is then boiled with sulfuric acid. The boiling results in the conversion of the sucrose to glucose, and in the sterilization of the liquid, and the latter is pumped by means of the pump P from the tank A through the pipe *a* and into the filter B. Here the liquid is filtered and the greater portion passes by means of the pipe *b* into the second diluting tank C. Here the liquid is again diluted and is passed through the refrigerator R where it is cooled before passing into the propagation tank D.

Owing to the fact, as shown later, that there is a continuous aerating of the liquid during the entire process of fermentation, a temperature of approximately 30° C. is maintained in the propagation tank. In this propagation tank are added the necessary nutritive salts, such as potassium sulfate, ammonium phosphate, etc., in the amounts needed.

During the filling of the propagation tank with the sugared liquid the latter is run into the tank to approximately one-fifth of the capacity of the tank and then a portion of the pure yeast is run in from the pure yeast apparatus E by means of the pipe *e*. The sugared liquid continues to run in until say approximately half of the tank is filled and then another portion of the pure yeast is run in from the tank E and the final portion of the yeast is sent in to fill the tank up to the level X. While this is being carried on, and in fact throughout the entire process, pure air is passed into the bottom of the propagation tank through the pipe *d* which connects with a pipe *f* leading to the air purifier and compressor F. This same pipe *f* enters the boiler A and during the boiling and diluting of the molasses air is passed in, thus tending to hasten the operation through the agitation effected by the passage of the air. The pipe *f* also communicates with the bottoms of the tanks C and E and the air tends to agitate the liquids in these tanks besides aerating them.

Right here I wish to call attention to the fact that in continuously aerating the liquid in the tank D, I provide the necessary amount of oxygen for the maximum propagation of the yeast because the latter if de-

nied the oxygen from the purified air would get it from the sugar, thereby forming alcohol. The continuous aeration of the liquid in the propagation tank I regard as one of the main features of the invention, because it is due to the fact that the oxygen is supplied to the yeast in sufficient quantity from the air and not from the sugar that I am able to manufacture a much larger amount of yeast from a given quantity of raw material than can possibly be manufactured by other processes in which such continuous aeration is not practised and in which the sugar is largely converted to alcohol in the propagation of the yeast. Now the alcohol produced of course can be utilized, but it is of much lower value than the yeast and consequently the difference in values is a direct loss to the yeast manufacturer. Besides supplying all the air necessary to the yeast cells, the air also serves as a temperature controlling agency and permits the work to be carried on with settings of 8 to 10 Baumé. As fast as the yeast is formed it comes to the surface of the liquid in the tank D in the form of a scum or blanket and here it is continuously skimmed off by mechanical means. This mechanical means is indicated at *m* in the drawing, but it will be understood that the illustration is purely diagrammatic, the mechanical device for carrying out this process being the subject of a separate application.

The scum or froth which is skimmed from the tank D passes downwardly through the pipe *q* to either of the centrifugal separators 1 or 2, depending upon which of these separators is in operation. The valves *h'* and *k'* in the pipes *h* and *k*, respectively, control the flow of the froth or scum containing the yeast when either of these valves is open and the other is closed, and the scum or froth will flow into the centrifugal separator past the open valve.

The purpose of having two separators is to permit the continuous operation of the apparatus as a whole while removing the yeast from one of the separators. These centrifugal separators are of large size and can be run at a slow speed as well as at a high one. They are provided with an exterior shell or casing such as that shown at *s* and an interior rotary part *s'* having perforated sides against which is disposed a felt lining s^2. The space between the inner and outer portions communicates with a discharge pipe *p* which leads into a liquid receiving tank T. A cold water pipe *t* has branches which enter the centrifugals so as to wash the yeast on the interior walls of the felt lining. The liquid is thrown with the yeast against the felt lining, the liquid passing through the lining and also through the perforated wall *s'* and is delivered by the pipe *p* into the liquid receiving tank. The yeast is retained by the felt lining. When a certain amount of the liquid has been separated from the yeast then the valve v' is closed and the valve v^2 is open. Cold water is now turned in by the opening of the valve v^2 in the pipe *t* and flushes the yeast which is held to the felt lining. This water passes on through the perforated sides of the centrifugal separators and out through the pipe V as waste water. The liquid in the receiving tank T is pumped by means of a pump U through the pipe *u* and into the compensating tank W. This tank is provided with an automatic regulator (not shown) for maintaining a constant level of liquid in the propagation tank.

After the yeast in the centrifugal separator has been washed the separator is further rotated to dry the yeast. The drying is further attained by adding to the yeast about 10% of its weight of fine starch or potato fecula, so that the yeast will be in good condition to be discharged from the separator and also that it may be easily handled when it is subsequently compressed and made into compressed yeast cakes. During the removal of the yeast from one separator, as stated, the other separator is brought into operation. It will be noted that the rotation of the separators tends to aerate the yeast. Thus it will be observed that all along through the entire process I supply the yeast with air. This, as stated above, tends to a larger production of yeast than could possibly be obtained where the process does not afford facilities for supplying the amount of air necessary for the maximum propagation.

When all the yeast that can be procured by gathering the scum has been recovered the valve *y* in the pipe Y at the bottom of the propagation tank is opened, thereby passing the liquid of the propagation tank through the centrifugal separator so that any yeast which is in the liquid and which did not rise to the surface in the form of scum is centrifugated out and is recovered in the separators. Here again the process differs from the ordinary process in which yeast in suspension in the liquid of the fermentation tanks is lost for the yeast manufacture.

The foregoing description of the process will enable one to readily see the advantages to be derived. The highest results obtained by ordinary processes in which the scum is removed from the propagating tank by hand are 24 kilograms of compressed yeast and 24 liters of alcohol (calculated at 100%) per hundred kilograms of grain.

By the process which forms the subject of the present invention by a pure yeast culture of a suitable liquid with the maximum of sugar the product of "dry yeast" will be 20% of the total weight of the sugar or

100% of the total weight of the sugar when made into compressed yeast, that is to say, 100 pounds C. P. sugar, can produce at least its weight in compressed yeast.

By my process it is true very little alcohol is produced for the reasons stated, but the purpose of the invention is to increase the yield of yeast at the expense of alcohol, since the yeast is the more valuable of the two.

There is another difference between the present process and that which has heretofore been used. The empirical preparation of heavy musts consists in making a sufficiently mucilaginous and viscous must of such a nature that the carbonic acid gas cannot easily separate itself from the globule of yeast, and carries it along to the surface of the must where it is gathered by skimming it by hand with a scoop. The yeast cells which do not rise to the surface, those that remain in suspension in the must, or those that sink to the bottom of the tank are lost in the manufacture of the yeast. Besides this the method of skimming by hand while the must is in full fermentation, takes away from the must a large amount of liquid containing unfermented sugars, which are lost when the yeast is washed. On the other hand, by the present process all of the sugar is utilized for yeast by passing the separated liquid from the centrifugals back into the propagation tank and in subsequently passing the contents of the propagation tank through the centrifugals.

It will thus be seen that I have provided a process in which a number of advantages are attained. A process of continuous aeration of the yeast during the entire period of yeast production; a process in which the operation is continuous; a process in which the aeration takes place in the separator; a process in which the separating and drying constitute virtually one operation, and finally, a process in which the spent liquid is returned to the propagating tank for propagating the undeveloped values.

I have spoken of the return of the liquid separated from the yeast cells, into the compensating tank W from whence it subsequently passes into the propagation tank. This liquid, as has been explained, has certain undeveloped values. I may add to the liquid enough sugared solution so as to bring the density of the main body of the yeast propagating liquid in the propagation tank D to its original density, thus utilizing to the fullest extent the liquid thrown off by the centrifugals.

I claim:—

1. The herein described steps in a process of making yeast, which consists in setting a sugared liquid for yeast propagation while continuously aerating the liquid, continuously skimming off the froth or scum containing the yeast at the top of the liquid, and continuously separating the yeast cells from the liquid portion containing the non-spent sugar, and returning the latter to the main body of the sugared liquid.

2. The herein described steps in a process of making yeast, which consists in setting a sugared liquid for yeast propagation while continuously aerating the liquid, continuously skimming off the froth or scum containing the yeast at the top of the liquid, and continuously separating the yeast cells from the liquid portion containing the non-spent sugar, by centrifugation in the presence of pure air and returning the latter to the main body of the sugared liquid.

3. The herein described process of making yeast, which consists in setting a sugared liquid for yeast propagation while continuously aerating the liquid, continuously skimming off the froth or scum containing the yeast at the top of the liquid, continuously separating the yeast cells from the liquid portion while simultaneously aerating the yeast cells and said liquid portion during said separation and returning said separated liquid portions to the main yeast propagating body.

4. The herein described steps in a process of making yeast, which consists in setting a sugared liquid for yeast propagation, continuously skimming off the froth or scum containing the yeast at the top of the liquid, continuously separating the yeast cells from the liquid portions containing the non-spent sugar, continuously returning the latter to the main body portion of the sugared liquid and in continuously aerating the yeast during the skimming and during the separation of the yeast from the liquid portion.

5. The herein described process of making yeast, which consists in propagating pure yeast in a pure sugared liquid in the presence of nutritive salts and air, continuously skimming off the scum or froth containing the yeast cells at the top of the liquid, continuously separating the yeast cells from the liquid, aerating the liquid during the entire period of propagation, and returning the separated liquid portion to the main body of the yeast making material, whereby the undeveloped values in the liquid thus returned may be propagated and recovered.

6. The herein described process of making yeast, which consists in propagating pure yeast in a pure sugared liquid in the presence of nutritive salts and air, continuously skimming off the scum or froth containing the yeast cells at the top of the liquid, continuously separating the yeast cells from the liquid, aerating the liquid during the entire period of propagation, returning the separated liquid portion to the main body of the yeast making material.

whereby the undeveloped values in the liquid thus returned may be propagated and recovered, and in subsequently subjecting all of the liquid which forms the main body of the yeast propagating material to centrifugal action whereby the yeast in the liquid is recovered.

7. The herein described process of making yeast, which consists in propagating pure yeast in a pure sugared liquid of a given density in the presence of nutritive salts and air, separating the scum containing the yeast thus propagated from the main body of the liquid, subsequently separating the yeast cells from the associated liquid of the scum, adding sufficient sugared solution to the separated liquid to bring the main sugared solution to its original density when the separated liquid is returned to it.

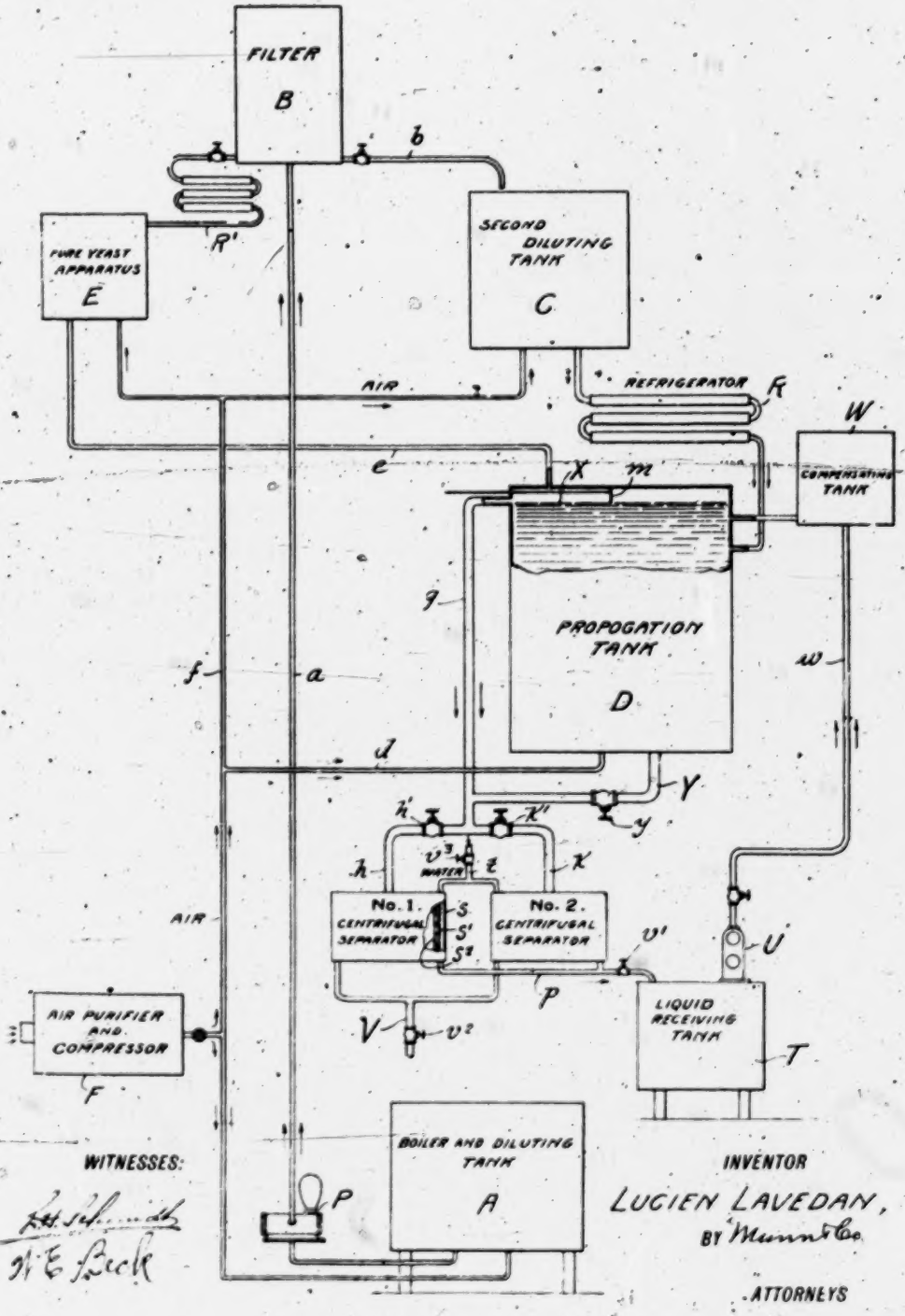
LUCIEN LAVEDAN.

L. LAVEDAN.

PROCESS OF MANUFACTURING YEAST.

APPLICATION FILED FEB. 12, 1916.

1,201,062. Patented Oct. 10, 1916.



WITNESSES:

H. E. Beck

INVENTOR

LUCIEN LAVEDAN,

BY Munn & Co.

ATTORNEYS

N° 20,787 A.D. 1892

Date of Application, 16th Nov., 1892
Complete Specification Left, 16th Aug., 1893—Accepted, 11th Nov., 1893

PROVISIONAL SPECIFICATION.

Improvements in the Manufacture of Yeast.

I, FLÉGONT MIKAÏLOVITCH POLSKY, of 65 Rue Emérian Paris in the Republic of France, Architect, do hereby declare the nature of this invention to be as follows:—

This invention relates to an improved manufacture of yeast without the production of alcohol.

The yeast employed in making bread and in distilleries is a product resulting from distillation in the same way that the yeast necessary for brewing beer is obtained during the brewing operation. It is unnecessary to describe here these two operations it being sufficient to note that in the actual processes only about one tenth part of the substance employed can be converted into yeast.

Knowing that yeast is much more costly quantity for quantity than alcohol or beer I have sought for and discovered a process by means of which I can convert nearly the whole of the substance employed into yeast without any portion being converted into alcohol.

In carrying out my invention I take a suitable quantity of green malt, or barley previously bruised, and the same quantity of flour prepared from wheat malt or from green or dry wheat malt, likewise bruised, and the same quantities of ordinary rye flour. I mix these ingredients together by adding thereto sufficient water heated to a temperature of from 50° to 60° C. to transform the substances employed into a paste which after carefully kneading I allow to remain for from 2½ to 3 hours in an open vessel to allow the substances employed to turn sour.

At the end of this time I add water at a temperature of from 90° to 95° C. as quickly as possible until the diluted mixture is of a temperature of from 62° to 65° C. I then cover the vessel and allow the mixture to remain for about an hour and a half to allow the farinaceous matters to be transformed into sugar.

On the mixture being uncovered I cool it as quickly as possible by plunging therein, for example in summer, vessels filled with cold water or ice, until the temperature falls to about 32° C. and I then add ordinary pressed yeast previously prepared in the following manner:—For the total of all the dry substances employed I take 10 *per cent.* of pressed yeast and after having diluted these two substances in water at 32° C. or in a portion of the mixture from the vessel the proportion being about four times more in weight than that of the yeast I allow the mixture to rest for about half an hour to allow the pressed yeast time to ferment. I then add for one gramme of pressed yeast 0·907 gramme or 0·908 gramme of tartaric acid ($C^4H^6O^6$); I then pour this mixture into the mixture in the vessel and about two hours afterwards I add the same quantity of bicarbonate of soda ($NaO, 2CO^2$) or carbonate of potash (KO, CO_2).

After adding the bicarbonate of soda I allow the mixture to remain for about four hours occasionally stirring it and during this time the process of the multiplication of the yeast commences.

Half an hour after having added to the mixture the yeast and substances above mentioned I commence to prepare a second mixture exactly in the same way as the first but taking only half the quantities of malts and flours and instead of adding thereto tartaric acid and bicarbonate of soda or carbonate of potash I add the same quantity of carbonate of ammonia (AzH^4Cl) or of sal ammoniac (H_4NCl) dissolved in a small quantity of water and poured into the fermented yeast in the same manner as described with reference to the first mixture.

[*Price 8d.*]

When the second mixture is ready I mix it with the first mixture and I then allow this fresh mixture to remain for from 6 to 8 hours to allow the yeast to form definitively after which the yeast is precipitated on the bottom of the vessel.

After passing the yeast through a sieve in order to separate it from the husks and other impurities, which I sometimes do before mixing the two mixtures together, I proceed to wash the yeast which is performed in a solution of phosphate of lime (Pho 3 CaO). I always prefer to employ the phosphate of lime throughout the process.

The pressing of the yeast does not differ from the processes at present in use and I do not therefore describe it.

By my improved process I can obtain a very white pressed yeast in the proportion of about 90 *per cent.* of the weight of the substance employed. If colour is not important, as it frequently is not, wheat flour need not be employed and the absence of this flour or of wheat malt greatly facilitates the process of multiplication of yeast. For the latter reason I sometimes dispense with the washing in the solution.

Dated this 16th day of November 1892.

G. F. REDFERN & Co.,
4, South Street, Finsbury, London, Agents for the Applicant.

COMPLETE SPECIFICATION.

Improvements in the Manufacture of Yeast.

I, FLÉGONT MIKAÏLOVITCH POLSKY, of 65, Rue Emériau, Paris, in the Republic of France, Architect, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to an improved manufacture of yeast without the production of alcohol.

The yeast employed in making bread and in distilleries is a product resulting from distillation in the same way that the yeast necessary for brewing beer is obtained during the brewing operation. It is unnecessary to describe here these two operations, it being sufficient to note that in the actual processes only about one tenth part of the substance employed can be converted into yeast.

Knowing that yeast is much more costly quantity for quantity than alcohol or beer I have sought for and discovered a process by means of which I can convert nearly the whole of the substance employed into yeast without any portion being converted into alcohol.

In carrying out my invention I take a suitable quantity of green malt, or barley previously bruised, and the same quantity of flour prepared from wheat malt or from green or dry wheat malt, likewise bruised, and the same quantities of ordinary rye flour. I mix these ingredients together and to one half the quantity I add sufficient water heated to a temperature of from 50° to 60° C. to transform the substances employed into a paste which after carefully kneading I allow to remain for from 2½ to 3 hours in an open vessel to allow the substances employed to turn sour.

At the end of this time I add water at a temperature of from 90° to 95° C. as quickly as possible until the diluted mixture is of a temperature of from 62° to 65° C. I then cover the vessel and allow the mixture to remain for about an hour and a half to allow the farinaceous matters to be transformed into sugar.

On the mixture being uncovered I cool it as quickly as possible by plunging therein, for example in summer, vessels filled with cold water or ice, until the temperature falls to about 32° C. and I then add ordinary pressed yeast previously prepared in the following manner:—For the total of all the dry substances employed I take 10 *per cent.* of pressed yeast and after having diluted this substance

in water at 32° C. or in a portion of the mixture from the vessel, the proportion being about four times more in weight of water than that of the yeast taken from the vessel, I allow the mixture to rest for about half an hour to allow the pressed yeast time to ferment. I then add for one gramme of pressed yeast 0·007 gramme or 0·008 gramme of tartaric acid ($C_4H_6O_6$): I then pour this mixture into the mixture in the vessel and about two hours afterwards I add the same quantity of bi-carbonate of soda ($NaHCO_3$) or carbonate of potash (K_2CO_3).

After adding the bi-carbonate of soda I allow the mixture to remain for about four hours occasionally stirring it and during this time the process of the multiplication of the yeast commences.

Half an hour after having added to the mixture the yeast and substances above mentioned I commence to prepare a mixture from the other half of the mixed ingredients exactly in the same way as the former mixture but instead of adding thereto tartaric acid and bi-carbonate of soda or carbonate of potash I add the same quantity of carbonate of ammonia $(NH_4)_2CO_3$ or of sal ammoniac (NH_4Cl) dissolved in a small quantity of water and poured into the fermented yeast in the same manner as described with reference to the first mixture.

When the second mixture is ready I mix it with the first mixture and I then allow this fresh mixture to remain for from 6 to 8 hours to allow the yeast to form definitively after which the yeast is precipitated on the bottom of the vessel.

After passing the yeast through a sieve in order to separate it from the husks and other impurities, which I sometimes do before mixing the two mixtures together, I proceed to wash the yeast which is performed in a solution of phosphate of lime ($Ca_3(PO_4)_2$). I always prefer to employ the phosphate of lime throughout the process.

The pressing of the yeast does not differ from the processes at present in use and I do not therefore describe it.

By my improved process I can obtain a very white pressed yeast in the proportion of about 90 *per cent.* of the weight of the substance employed. If colour is not important, as it frequently is not, wheat flour need not be employed and the absence of this flour or of wheat malt greatly facilitates the process of multiplication of the yeast. For the latter reason I sometimes dispense with the washing in the before mentioned solution of phosphate of lime.

My process enables me to obtain yeast by employing any kind of farinaceous cereals and other vegetables containing starch.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A process for manufacturing yeast, preferably pressed yeast without the production of alcohol consisting essentially in taking a suitable quantity of green malt, bruised barley for example, and a like quantity of flour prepared from wheat malt or a like quantity of green or dry wheat malt likewise bruised, mixing these quantities of barley and malt flour or wheat malt, dividing the mixture into two equal parts and adding to each part water at 50 or 60 degrees C., kneading the paste so obtained and leaving it to rest in an open vessel to allow the substances to turn sour, adding water at 90 to 95 degrees C. in order to obtain a temperature of 62 to 65 degrees C., the vessel being then covered and the mixture left to rest to allow the farinaceous matter to be converted into sugar, quickly cooling the mixture until the temperature falls to about 32 degrees C., adding ordinary pressed yeast, diluting the mixture in water at 32 degrees C. and adding, after a period of rest, tartaric acid and bi-carbonate of soda or carbonate of potash; preparing in a similar manner a second mixture with the other half of the malts first referred to, but substituting carbonate of ammonia or sal ammoniac for the tartaric acid and bi-carbonate of soda or carbonate of potash, mixing the two mixtures, leaving the whole to rest for 6 to 8 hours, passing the yeast through a sieve, and washing and

pressing it by the ordinary methods, one or more washings being effected, if required, in a solution of phosphate of lime, the wheat flour being omitted if it is not required to produce a colourless yeast substantially as hereinbefore described.

2. As a new commercial product the pressed white or coloured yeast resulting from the process described without the production of alcohol.

Dated this 16th day of August 1893.

G. F. REDFERN & Co.,
4, South Street, Finsbury, London, Agents for the Applicant.

London: Printed for Her Majesty's Stationery Office, by Darling & Son, Ltd.—1893

N° 21,011 A.D. 1896

Date of Application, 22nd Sept., 1896
Complete Specification Left, 21st June, 1897—Accepted, 14th Aug., 1897

PROVISIONAL SPECIFICATION.

A New or Improved Method of and Apparatus for the Manufacture of Pure Yeasts.

I, GEORGE EUGÈNE JACQUEMIN, Chemist, of Malzéville, near Nancy, France, do hereby declare the nature of this invention to be as follows:—

The object of my invention is a new or important method of and apparatus for the manufacture of pure Yeasts.

The employment of pure wine Yeasts which I was the first to recommend five years ago in substitution for Yeast from grain or beer, is very advantageous, especially since the improvement which I have made in the manufacture of this Yeast rendering it by special culture more resistant to bacteria; my new method allows pure Yeasts to be used freely by reason of their continuous, convenient and rapid manufacture.

For the purpose of my invention, I employ a sterilizer supplied with molasses (preferably at the lower part) at about 28° Baumé, but any other fermentable sugared wort may be employed with the addition of other matters or ingredients useful for fermentation, as for example, Maltopeptone, Phosphate of Ammonia, *etc.*: and which are submitted to a long sterilization by steam clearing by any suitable means. This sterilizer may serve for saccharifying the grain for the preparation of a thick Yeast.

When the sterilizing operation is complete the steam inlet is shut off and air is forced in by an air compressor, and an outlet cock at the upper part of the apparatus is opened, the sterilizer being cooled at the same time which may be easily effected by a sheet of water flowing down its sides.

When the wort thus treated is at a temperature of 28° to 30° C. it is conducted by a pipe into a vessel for producing the first Yeast.

The quantity of wort usually introduced is about a hectolitre; the selected pure Yeast is introduced at the Thermometer opening, so that the interior of the vessel should be as little as possible in contact with the exterior atmosphere. The Thermometer is then replaced and the Yeast is aërated during the fermentation (revived) of the Yeast; when this takes place and the fermentation is well in activity this first Yeast is passed into a receiver of a larger capacity and sterilized wort from the sterilizer is poured on this Yeast, which results in a new and very important multiplication of Yeast. These substances or materials are then aërated during about 12 hours and a certain quantity is then drawn off into a vat, and which is charged with wort. In this way, a third-Yeast is obtained which as soon as made is directed, according to the requirements of the manufacture, into fermenting vats.

The quantity of Yeast taken from the receiver is replaced by an equal quantity of sterilized wort from the sterilizer, and so on each three, four, five, or six hours depending on the number of vats to be fermented during 24 hours or longer and according to whether the Yeasts remain pure, or commence to be contaminated.

[*Price 8d.*]

If contamination is produced the operations are recommenced with pure Yeast as explained above.

In my arrangement of apparatus, I connect the air conduits and the wort conduits to the steam pipe, so that the sterilizing can proceed when necessary.

In the same way the air forced by the compressor into the air reservoir will be sterilized in passing through one or more filters with filtering media such as antiseptic wadding &c. The sterilizing of the air may be completed by washing it in antiseptic solutions.

I do not limit myself to the manufacture of pure wine Yeasts for which my method is particularly advantageous, and it is understood that my method and arrangement of apparatus may be applied to the continuous production of any other kind of Yeasts.

I may also replace the aëration by the introduction of Oxygen which may be effected by means of tubes containing this gas in a compressed state as sold commercially, thus avoiding a special installation for the purpose.

I may also dispense entirely with any aëration or oxygenation for the production of pure Yeasts, my experience proving that this may be done by employing a nourishing wort richer in matters assimilable by the Yeast; this last mode of operation is more costly but where for certain cases or reasons, the aëration or oxygenation cannot be employed, it is capable of rendering useful service.

Dated this 22nd day of September 1896.

H. GARDNER,
166 Fleet Street, London, Patent Agent,
Agent for the said George Eugène Jacquemin.

COMPLETE SPECIFICATION.

A New or Improved Method of and Apparatus for the Manufacture of Pure Yeasts.

I, GEORGE EUGÈNE JACQUEMIN, Chemist, of Malzéville, near Nancy, France, do hereby declare the nature of this invention and in what manner the same is to be performed to be particularly described and ascertained in and by the following statement:—

The object of my invention is a new or improved method of and apparatus for the manufacture of pure Yeasts.

The employment of pure Wine Yeasts, which I was the first to recommend five years ago in substitution for Yeast from Grain or Beer, is very advantageous, especially since the improvement which I have made in the manufacture of this Yeast rendering it by special culture, more resistant to bacteria; my new method allows pure Yeasts to be used freely by reason of their continuous, convenient, and rapid manufacture.

In the annexed drawings, I show (as an example) the general arrangement of apparatus for this manufacture, but the details and accessories, pipes &c. may be modified without altering the principle of my invention.

A, is a sterilizing receiver of the worts. B, is a receiver for mother Yeast (levure mère). C, is a receiver for developing the Yeast. D, is a preparation vat. E, is a fermentation vat. F, is an air compressing apparatus. G, is a compressed air reservoir. H, is an air filter. I, I, are the conduits for the worts, and I', I', the conduits for the sterilized worts. J, J, the steam pipes. K, K, the air pipes.

The receiver A is a sterilizer supplied with all the necessary adjuncts, it can be cooled in any convenient manner, the molasses which I use for my process is placed in it (preferably at the lower part of the receiver) at about 28° Baumé, but any other fermentable sugared wort may be employed with the addition of other matters or ingredients useful for fermentation, as for example:—Maltopeptone, Phosphate of Ammonia, *etc.*: and which are submitted to a long sterilization by steam. This sterilizer may serve for saccharifying the Grain for the preparation of a thick Yeast.

When the sterilizing operation is complete, the steam inlet is shut off and air is forced in by an air compressor, such as at F, and an outlet cock at the upper part of the apparatus is opened, the sterilizer being cooled at the same time, which may be easily effected by a sheet of water flowing down its sides.

When the wort thus treated is at a temperature of 28° to 30° C. it is conducted by a pipe I^1 into a vessel B which is a receiver for producing the first Yeast. This vessel B should be previously sterilized.

The quantity of wort usually introduced is about a hectolitre; the selected pure Yeast is introduced at the Thermometer opening, so that the interior of the vessel or receiver should be as little as possible in contact with the exterior atmosphere. The Thermometer is then replaced and the Yeast is aërated for the reviving fermentation; when this takes place and the fermentation is well in activity, this first Yeast is passed into another receiver C of a larger capacity, and sterilized wort from the sterilizer A is poured on this Yeast, which results in a new and very important multiplication of Yeast. These substances or materials are then aërated during about 12 hours, and a certain quantity is then drawn off by the cock P into a vat D standing on legs and which is then charged with wort. In this way, a third Yeast is obtained which as soon as made is directed according to the requirements of the manufacture into the fermentation vats E.

The quantity of Yeast taken from the receiver C is replaced by an equal quantity of sterilized wort from the sterilizer A, and so on for each three, four, five, or six hours depending on the number of vats to be fermented during 24 hours or longer, and according to whether the Yeasts remain pure, or commence to be contaminated.

If contamination is produced, the operations are recommenced with pure Yeast, as explained above.

In my arrangement of apparatus, I connect the air conduits K and the wort conduits I^1 to the steam pipe J, so that they can be easily sterilized when necessary.

In the same way, the air forced by the compressor F into the air reservoir G will be sterilized in passing through one or more suitable receivers H provided with filtering substances such as antiseptic wadding &c. The sterilizing of the air may be completed by washing it in antiseptic solutions but this is not indispensable.

As before stated, I do not limit myself strictly to the manufacture of pure Wine Yeasts, for which my method is particularly advantageous, and it is understood that my method and arrangement of apparatus may be applied to the continuous production of any other kind of Yeasts.

I may also replace the aëration by the introduction of oxygen which may be effected by means of tubes containing this gas in a compressed state as sold commercially, thus avoiding a special installation for the purpose.

I may also dispense entirely with any aëration or oxygenation for the production of pure Yeasts, my experience proving that this may be done by employing a nourishing wort richer in matters assimilable by the Yeast; this last mode of operation is more costly, but where for certain cases or reasons the aëration or oxygenation cannot be employed, it is capable of rendering useful service.

Having now particularly described and ascertained the nature of this invention and in what manner the same is to be performed I declare that what I claim is:—

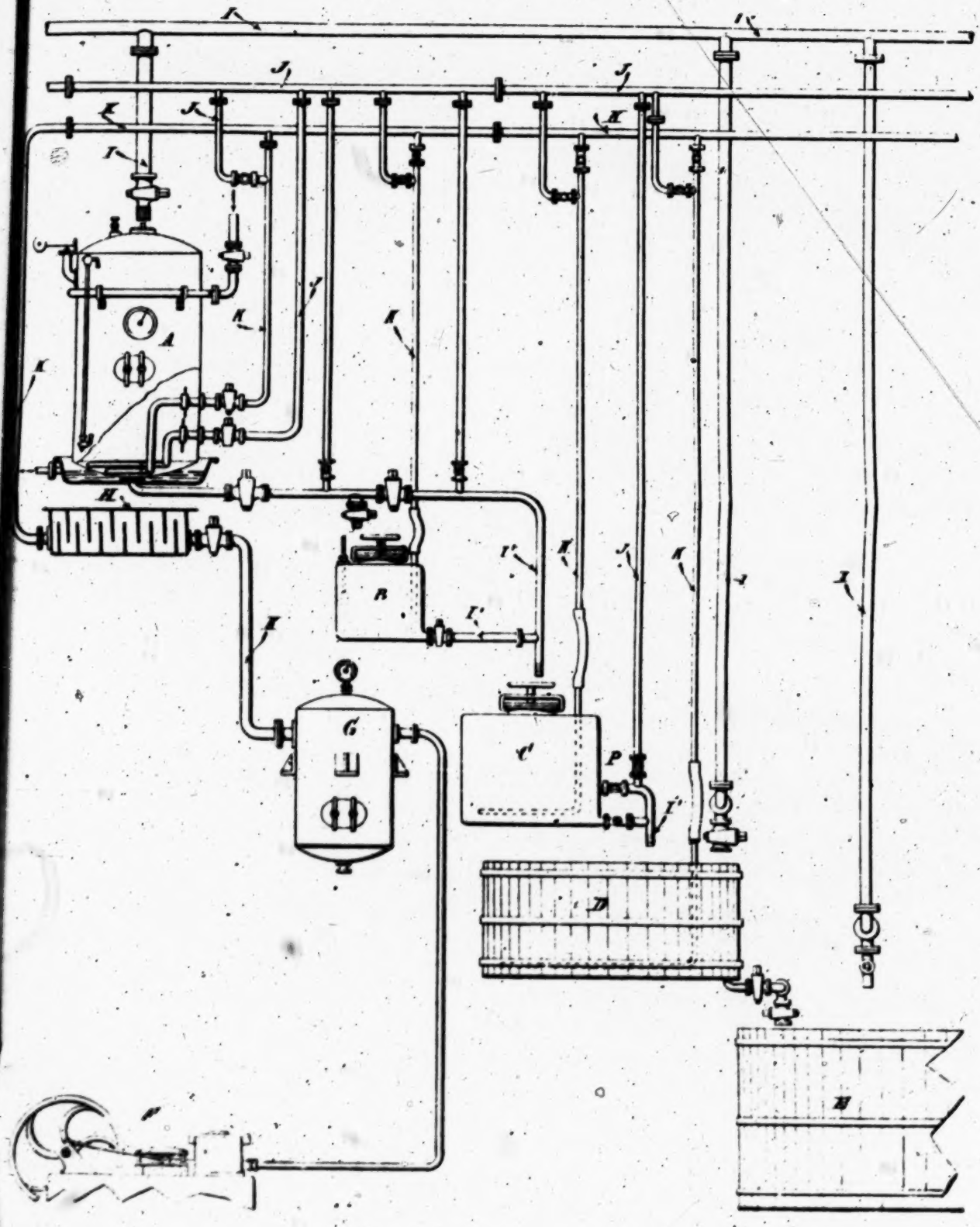
The new method of continuous manufacture of pure Yeasts above described, and

the employment of the arrangement of apparatus shown as an example on the annexed drawing.

The 21st day of June 1897.

H. GARDNER,
166 Fleet Street, London, Patent Agent,
Agent for the said George Eugène Jacquemin.

Redhill: Printed for Her Majesty's Stationery Office, by Malcomson & Co., Ltd.—1897.


A
B
C
D
G
P

N° 11,617 A.D. 1913

(*Under International Convention.*)

Date claimed for Patent under Patents and Designs Act, 1907, being date of first Foreign Application (in France), 25th May, 1912

Date of Application (in the United Kingdom), 19th May, 1913

At the expiration of twelve months from the date of the first Foreign Application, the provision of Section 91 (3) (a) of the Patents and Designs Act, 1907, as to inspection of Specification, became operative

Accepted, 30th Apr., 1914

COMPLETE SPECIFICATION.

Improvements in Yeast or Ferments for use in Fermentation and Distillation Processes.

I, ALFRED MOLIHANT, of The Hainaut Institute of Hygiene and Bacteriology, Mons, Belgium, Chemist and Engineer, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention has reference to improvements in yeast or ferments for use in fermentation and distillation processes and is intended more particularly for bringing about the fermentation of molasses or other fermentable liquids under such conditions that the wash constituting the residue of their distillation may be evaporated without incrusting the tubular apparatus which is employed for this purpose.

It is known that the usual operation for sulphuric acidification of mash or wort, particularly when the liquids are charged with earthy alkaline salts, brings about incrustation which interferes with the normal working; on the other hand, hydrochloric acidification obviates that difficulty but necessitates the employment of considerable quantities of hydrochloric acid, and this occasions very serious inconvenience on several grounds but more particularly because the acid rapidly attacks the whole of the apparatus; finally, working with hydrochloric acid in the usual way necessitates strong acidity in hydrochloric acid to obviate the overrunning of the liquid in fermentation by numerous bacteria which diminish considerably the output of alcohol.

In order to attain the object aimed at, *i.e.* the obviation of any incrustation of the evaporating apparatus, working with hydrochloric acid would be perfect if the operation could be carried out with very small doses of acid and if microbic infection could be prevented in these conditions. I have found as the result of many experiments that a yeast or ferment of a pure or composite stock acclimatised to hydrochloric acid, added together with the liquid in which it is cultivated and preserved, and which it has caused to ferment, to molasses or other alkaline fermentable liquid which has been diluted with water so as to obtain a reaction almost neutral to litmus, so that the mixture is only slightly acid, enables the fermentation of sugar juices to be carried right to the end

without bringing about infection. This result can only be obtained if the ferment which is forced to live in a medium acidified by hydrochloric acid has been itself accustomed to increasing doses of formic aldehyde. A ferment acclimatised by preliminary cultures in a formolated medium until the critical dose is arrived at, then transferred into a hydrochloric medium, and thence into an almost neutral medium, such as crude molasses diluted and only slightly alkaline, has the interesting property that it offers a considerable resistance to bacterial invasion.

A suitable liquid in which to sow and nourish the yeast is a solution of 70 grammes of sugar candy, 4 gr. each of tartaric acid and nitrate of ammonium, 0·6 gr. each of phosphate of ammonium and carbonate of potassium, 0·4 gr. of carbonate of magnesium, 0·25 gr. of sulphate of ammonium, and 0·07 gr. of silicate of potash in 1500 gr. of water with the addition of 0·2 to 0·3 gr. of formic aldehyde per litre. The yeast grown in this medium is placed together with the said medium in propagating vats and is developed and acclimatised to hydrochloric acid in molasses diluted with water and acidified by the addition to each litre of 3·5 gr. of commercial hydrochloric acid of 20° Bé., the vats being filled up gradually, and then crude molasses is added in the proportion of about 2 to 1, the proportion being varied according to the nature of the molasses and the working conditions.

The process described obviates all the difficulties referred to. Mash or wort fermented with a yeast or ferment that has been subjected to the treatment described yields a wash that can be concentrated without any difficulty. My process has other advantages in that it obviates the denitration and sterilisation necessary in the process hitherto followed.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:—

1. In processes of fermentation of molasses and other fermentable liquids, the employment of yeast or ferment of a pure or a composite stock acclimatised to hydrochloric acid after having been previously accustomed to live in formolated mediums.

2. Yeast or ferment for use in the fermentation of molasses and other fermentable liquids, acclimatised to live in a medium acidified by hydrochloric acid after having been previously accustomed to increasing doses of formic aldehyde.

Dated this 19th day of May, 1913.

BAUER, IMRIE & SLACK.
Chartered Patent Agents & Consulting Engineers,
72—74, Cannon Street, London, E.C.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1914.

GERMAN PATENT NO. 10135

PATENT SPECIFICATION

1879 No. 10135 Class 6.

DR. JACQUES RAINER in VIENNA

PROCESS OF MANUFACTURING PRESSED YEAST WITHOUT ALCOHOLIC FERMENTATION AND WITHOUT THE FORMATION OF BY-PRODUCTS.

Patented in Germany, from Oct. 12, 1879 on.

My invention is based on the ~~discovery~~ experience derived from intensive studies and experiments that the culture (growing) of the yeast plant (Sacharomices cerevisiæ) can take place in suitable media not only without fermentation, but that also the cells formed by a simple process of vegetation, in other words the application of the above principle, can be utilized for the ~~commercial~~ industrial production of pressed yeast.

The procedure for the commercial production of the new pressed yeast is as follows:

The vegetable proteins derivable from cereals, corn, legumes, or industrial offals, such as bran, malt ~~germs~~ sprouts, spent grains, gluten, etc., are extracted with from 15 to 20 times their weight of slightly alkaline water and peptonized with lactic acid, added in excess (about 4%), or with mineral acids (phosphoric acid, about ¼%, sulphuric or hydrochloric acid, about 4/10%) at a temperature of from 30 to 32° R., or they ~~can~~ may also be immediately macerated with the said acids in weak solutions and at the same time converted into peptones. (In this connection it is to be stated that a portion of the proteins contained in dry malt ~~germs~~ sprouts,

viz. from 5 to 10% of the aggregate weight, is already peptonized by the preceding process of vegetation.)

The peptonization of the proteins is effected in the case of cereals, corn or legumes, as also in the case of brans or gluten, through an addition of diastase for which purpose the addition of one part by weight of sprouts dry malt or five parts by weight of malt ~~germs~~ for every part by weight of the dry weight of the proteins is amply sufficient; as mentioned before, the liquid in which the proteins are to be converted into peptones must contain lactic acid (about 4%), phosphoric acid (up to ¼%), sulfuric or hydrochloric acid (about 2/5%), as the presence of these acids is absolutely necessary for the process of peptonization.

The most suitable temperature for the peptonization is about 30° R., and a period of from 18 to 20 hours is sufficient for bringing it about, but nearly perfect results may ~~can~~ also be attained at lower temperatures and within a proportionally longer period of time.

In working up malt sprouts ~~germs~~ alone, an addition of malt is superfluous, the diastase contained therein being more than sufficient for the process of peptonization, so that the only requirement is the utilization of one of the acids mentioned above in the stated proportions.

The mixing of the malt sprouts ~~germs~~ with water can be carried out by hand or by means of a mechanically driven agitator. When preparing a mash of malt or cereals, in other words when preparing the required maltose, dextrose, etc., I use the usual factory equipment while applying the commonly used temperatures and concentration ratios.

Let it be further stated that due to the diastase in conjunction with acids even the mucilaginous pectates contained both in the malt ~~germs~~ sprouts and in other materials are liquefied, and when one is concerned with the preparation of pure peptones, these pectates can be separated by an endosmotic apparatus or dialyzer, in such a manner that the peptones dialyze in water through suitable membranes, whilst the gelatinous pectates remain behind as a residue.

The neutralization of the acids is effected by means of soda or by saturating the liquid with basic calcium phosphate, as about to be described.

The finished peptonic liquid, either with or without sugar content can be evaporated in a water or vapor bath, or, better still, in a vacuum to the consistency of a syrup or extract, or even to a dry condition, so that it ~~can~~ may be used in this state as a material fit for transportation.

The peptone-containing liquor is separated from solid matter (carbohydrates, vegetable fibres, etc.) by a simple lixiviation (maceration) or by pressing or centrifugation and in any event is carefully purified besides by filtration or sedimentation. Prior to purifying it by filtration or settling, it is advisable, however, to neutralize the acid present therein by means of soda or to saturate the liquid with basic calcium phosphate, the latter method being preferable as in this way the yeast is amply supplied with the necessary phosphoric acid.

Depending upon the peptone content of the liquor dextrinized starch which was converted into dextrose in the known manner by boiling it in the presence of mineral acids in an amount equal to about one-half of

the dry weight of the peptone, or maltose, molasses, or finally, sugar with a small amount of inoculating yeast (beer yeast or pressed yeast), is added to start the yeast growth, the mentioned carbohydrates, however, being always limited to no more than from ½ to 1% of the weight of the total liquor and being exclusively used for the formation of cellular tissue.

The vegatation of the yeast will take place in the best and most reliable manner at temperatures of from 14 to 17° R., as in the case of higher temperatures and also, when a greater amount of carbohydrates is added, losses are very apt to ensue due to the fact that the varieties of sugar used are partly converted into lactic acid or undergo alcoholic fermentation instead of merely supplying the cellular substance of the yeast.

The cultivation of yeast is carried out, as is customary in Holland, either in flat vessels (level of liquid about 14 cm high) in order to afford access of a sufficient amount of atmospheric air, or in a better and safer way, in fairly deep tubs made of wood, glass, cemented masonry or any other suitable material, into which atmospheric air is injected through hose or piping by means of mechanical force, by means of blowers or compression pumps, and in as finely divided a condition as possible as by means of sprinklers or similar devices.

It is even more advantageous to use instead of atmospheric air an air of increased ozone content or ozonized oxygen. The later is produced by successive additions of hydrogen peroxide to the nutrient solution, whereas the ozonization of the atmospheric air is brought about by means of phosphorous or by causing the atmospheric air to pass through a sealed vessel containing potassium permanganate and the necessary mineral acid and only then passing the air enriched with ozone into the nutrient solution.

According to the greater or lesser density of the nutrient liquor used, and according to the higher or lower temperature thereof, and also depending upon the amount of ozonized air that is introduced, the growth of the yeast after each substantial addition of dextrose, maltose, etc., is completed within from 6 to 8 hours. The peptone content of the mass may amount to 1-2% of the weight thereof, and even more, whereas in each instance only ½-1% of dextrose or other carbohydrate shall be added in order to suppress lactic acid or alcoholic fermentation with certainty, and thus also to avoid any losses in my process caused thereby.

When after a period of from 6 to 8 hours the added dextrose or other variety of sugar has been consumed entirely or at least the greatest part thereof for the growth of the yeast, an additional portion containing from 1/20 to 1/10% is added and likewise the peptones after having been consumed can be added again to the liquor, either in portions or in a slow and continuous stream, so that the same nutrient solution can with successive replacement of the consumed substances remain in use for entire weeks or months, unless it has been contaminated by other substances or secondary ferments and thus made unfit for further use.

In proportion as the materials required for yeast culture are added in portions, the yeast produced likewise is withdrawn successively and only the yeast which is still suspended in the liquor itself remains behind as ~~an inoculant~~ seed for the alcoholic ferments still to be formed.

Recovery of the yeast is effected as follows: It is skimmed off from the surface of the liquor, or after drawing off the latter it is taken from the bottom of the vessels upon which it has settled out as a fairly compact layer. In the latter case, it is advisable for

more extensive operations to mount the vessels in tier batteries, so as to permit of transferring the nutrient solution from one into the other.

In order to produce a yeast as pure as possible and free from secondary ferments, the nutrient solution can also be prepared in a thinner form ~~of~~, ~~as the example case may be~~, with a peptone content of from only ¾ to 1%, and the carbohydrates (dextrose, maltose, etc.) can likewise be added in smaller amounts (as the first dose about 1/3%, then ~~in~~ 3 to 3 hours about 1/20%), in which case the available peptones will be converted into yeast within from 12 to 15 hours at a temperature of from 16 to 17° R., provided a sufficient amount of pure air, possibly passed through sulphuric acid, or ozonized oxygen, is supplied. The whole liquor is then cooled by means of a refrigerator or through the addition of cold water or ice, if possible to 6-8° R., and the yeast obtained will settle out almost completely within from 12 to 14 hours on the bottom of the vessel from a height of liquid of from 80 to 90 cm., whereupon the spent nutrient solution can be drained off into the sewer.

The ~~steps of~~ purifying and pressing of the yeast prepared in accordance with my new process is carried out in the known manner, but in order to give it better keeping properties calcium phosphate can even prior to compression be added thereto in an amount corresponding to 5-10% of the total weight of the yeast to be finished.

According to results obtained up to the present, from 250 to 300 kg of a pure and vigorous pressed yeast can be obtained from every 100 kg of pure peptone (dry weight), only about 200 kg of dextrose or sugar being required for its cultivation.

PATENT CLAIMS

1. The culture of yeast cells from vegetable peptones with small additions of dextrose, maltose, or similar carbohydrates, which latter, however, are used exclusively for building up the cell walls.

2. The successive admission of peptones and carbohydrates into the relatively stable nutrient solution intended for yeast culture, and likewise, the successive withdrawal of the finished yeast, both in the proportions stated.

3. The process, based on the foregoing, of producing pressed yeast on an industrial scale, with exclusion of the customary alcoholic fermentation and without any by-product in the form of alcohol or vinegar.

GERMAN PATENT OFFICE

PATENT SPECIFICATION

No. 269,192.

Class 6a.

Group 16.

ISSUED JANUARY 12, 1914.

ADAM KAMIENSKI in DRESDEN.

PROCESS OF PRODUCING COMPRESSED YEAST FROM WORT BY THE AERATION PROCESS.

Date of patent in the German Empire:
September 20, 1912.

According to the new process the mashing and clarification may be carried out as desired according to known methods of working. Of the strong first wort draining from the clarifying vat of about 10 to 12° Balling one-third is held back in a vessel which is arranged above the fermenting vat, while the other two-thirds of the first wort drain into the fermenting vat. When these two-thirds of the first wort have been diluted by continued spargings to 8° Balling, two-thirds of the entire quantity of pitching yeast (which represent 8% of the mash materials) are added. Thereupon at a fermenting temperature of 23° R. (28.7° C.) slight aeration is started, and the wort in the fermenting vat is so far diluted by spargings that its saccharometer reading amounts to 3° Balling.

Air is then introduced in full amount and the fermenting temperature is lowered to 20° R. (25° C). The vat content then is given a chance to rise to 22° R. (27.5° C), the fermenting temperature is again de-

pressed to 20° R. (25° C.) and this raising of the temperature and subsequent depression will be repeated until the sacchorometer reads 1.8° Balling. Now the held back one-third of the first wort to which the retained one-third of the pitching yeast was added beforehand, is run to the fermenting vat. The fermenting temperature which now rises strongly is lowered to 20-22° R. (25-27.5° C.) and this temperature is maintained until the wort has been fermented to 1.2° Balling. At 1.2° Balling the contents of the vat are once more allowed to reach 24° R. (30° C.) and the yeast is separated from the wort in the customary manner when the latter has been fermented down to 0.7-0.8° Balling.

It is true that in the wort aerating process the wort at times is diluted to 3° Balling and then fermented, but in such cases the fermenting temperature is maintained at 17-18° R. (21-25.5° C). The wort in this process is strongly utilized and the yield of yeast is increased. On the other hand, fermentation at the lowered fermenting temperature requires relatively much time. Owing to the high fermenting temperature of the new process at the same time a reduction of the fermenting period is gained. In order, however, to prevent too fast fermentation, the fermenting temperature is periodically lowered which process is also known as such in the aeration yeast practice. The advantage of fermentation of highly diluted wort at a high fermenting temperature, as used according to the present process is based in opposition to fermentation of highly diluted wort at a fermenting temperature maintained on a low level on the fact that not only an increase of the yeast yield, but at the same time a reduction of the fermenting period is brought about.

Naturally when the fermenting temperature is maintained on a relatively high level of at least 20° R. (25° C) less advantage is taken of the raw material than in the case of slow fermentation at a low ferment-

ing temperature. As a compromise the pitching yeast is added in two stages together with the addition of the retained first wort. In this manner new nourishment is not only brought to the already fermenting fluid, but also, by means of the newly arriving pitching yeast further fermentation is introduced, in which the nutritive substances of the liquid are further utilized. Advantage is also taken of the material by the fact that the new vigorously beginning fermentation is going on in a wort which still is relatively thin.

There is likely to be occasionally in the process of yeast manufacture a second seeding with pitching yeast, but until now the latter was distributed in water and admixed to the already fermented liquid. But by this means a but insignificant new fermentation is brought about, because the already fermented liquid naturally offers little new nourishment to the newly arriving pitching yeast. The fundamental and novel idea connected with the present process is that the second seeding of the pitching yeast is performed before the fermentation is completed while concentrated wort is added.

While with the use of the well known yeast aeration process aeration as a rule requires a period of 12 hours, under the new process an aeration period of only 8 hours is needed, and in this manner a yield of from 36 to 40 percent of unobjectionable yeast is secured which is noted for keeping quality.

GERMAN PATENT SPECIFICATION No. 269,192

PATENT CLAIM

Process of producing compressed yeast from wort according to the aeration process alternately causing the fermenting temperature to rise and to lower, characterized in that wort and pitching yeast are successively used in two parts in a manner such that in the

first place two-thirds of the first wort diluted by spargings to about 8° B. are set to ferment with two-thirds of the pitching yeast; then the wort is diluted in the fermenting tub by sweet-water to about 3° B. and fermented to about 1.8° B. whereupon the held back one-third of the pitching yeast which is partly fermented in the retained one-third of the first wort is admixed to said fermented wort and the whole mass is fermented in the known manner.

ORIGINAL GERMAN PATENT NO. 269,192.

(Physical Exhibit.)

FRANCE

NATIONAL OFFICE OF INDUSTRIAL PROPERTY

PATENT No. 470,925

II—Alimentation

5.—Beverages, wines, vinegar, cooperage

PROCESS FOR OBTAINING MOLASSES YEAST.

Mr. Gustav Roth, residing in Austria.

Applied for March 30, 1914, at 3:47 P. M. in Paris.

Delivered June 27, 1914—Published Oct. 6, 1914.

(2 patent applications filed in Austria on April 2, 1913 and March 12, 1914—Statement of the applicant).

The treatment of molasses for manufacturing yeast presents, as is known, certain difficulties, especially in warm weather. It is particularly in regard to the regularity of quality that the product is not satisfactory. Sometimes the yeast is in good condition, but frequently one sees it assume a bad color accompanied by infections. Besides these drawbacks which become apparent when using the molasses for yeast making in general, there are, as is known, molasses of different origins and not all of them are suitable in an equal degree for the manufacture of yeast, with the present-day processes.

The present invention gives the solution of the problem consisting in obtaining in a reliable way with molasses a yeast of good quality, and that with or without intervention of lactic acid.

Ordinarily, in order to obtain the must by employing mineral acids exclusively (that is to say without production of lactic acid by the bacterial method) one proceeds as follows: After having diluted the molasses with water it is neutralized by mineral acids (sulphuric acid or hydrochloric acid) or, to speak more precisely,

there is added to it a small excess of acid so that the degree of acid represents 1.5 per 100 cm^3 of the mixture; it is heated by steam for a sufficient length of time in order that the molasses, freed from a dark slime which has settled during the cooling, yield a sufficiently clear product, which contains all its sugar in the state of dextrose. The clear liquid is placed in the maceration vat, then, after it has been brought to the desired degree of concentration and of acidity, there are mixed with it malt ~~germs~~ sprouts and it is passed into the clarification vat.

When one has recourse to the production of lactic acid by the bacterial method, the operation usually carried out for obtaining the clear must is the following: The molasses having been, as stated above, clarified by acidification by means of mineral acids and by boiling, the malt ~~germs~~ sprouts are wetted down and acidification is allowed to proceed in the vat. (The operating of mashing the ~~germs~~ sprouts can, however, be effected after the acidification). In order to bring about the acidification lactic acid bacteria are sown by means of a small starter of dry malt and rye, or by means of a certain quantity of a sufficiently acid must (coming from a preceding operation). When the must has attained the desired degree of acidity, it is sterilized by heating it up to 75° whereupon it is poured into the clarification vat.

After long tests it has been found that impurities still exist in the solution of molasses prepared and acidified in the ordinary way, then drawn off clear after boiling. These impurities are set free in very fine suspension when the molasses has been diluted a second time, acid added thereto, and is vigorously stirred or aerated. If the solution is then subjected to filtration by which it is freed from these very fine impurities, one obtains a clear liquid from which one gets regularly a

yeast of excellent quality. Another advantage of the new process is that the solution can be run directly into the fermentation vat in which there can be added clear extracts which contain the nitrogenous elements of the must. The filtration of the must becomes superfluous by the fact of inserting in accordance with the new process between the successive operations at present carried out, a second purification of the already clarified molasses solution. This results not only in a great simplification of the operations, but which is more important, one also avoids the troubles due to the fact that with the present method of filtration of the must prior to fermentation, the malt ~~germs~~ sprouts retain, more or less the very fine impurities still existing in the molasses, in spite of its clear appearance; now these impurities, as has been shown by precise experiments, injure considerably the quality of the yeast and consequently have a vital effect on this quality.

When one has recourse to the formation of lactic acid, the molasses solution purified in accordance with the new process, is treated with nitrogenous clear extracts, such as vinasse, nutritive or other salts, after having added thereto a powerful lactic acid ferment in the form of clear must, acidification is allowed to proceed for some hours, after which it is run off into the fermentation vat. In this case, too, the must is not filtered. It is of course understood that one could also proceed in such a way that a part of the lactic acid or even all the lactic acid will be produced prior to the filtration of the molasses.

Here are some examples of application of the process:

The molasses diluted to 35° Balling is treated with sulphuric acid in the proportion of 4 cm^3 per 100 cm^3 of the mixture, whereupon according to its quality it is subjected to a boil lasting several hours, after which

it is allowed to clear up. The clarified solution is drawn off, again diluted to 20° Balling, and sulphuric acid is added to it so that the degree of acid is the equivalent of 6 to 10 cm^3 per 100 cm^3. It is advisable then to aerate it for a certain time. The impurities are precipitated in a very finely divided form and are eliminated by a cautiously conducted filtration.

When one makes use of mineral salts exclusively, the purified molasses is placed directly into the fermentation vat and is made to ferment with clear nitrogenous extracts, vinasse, nutritive salts, etc. When one makes use at the same time of lactic acid of fermentation, the purified molasses solution that has become clear, is mixed in a vat with nitrogenous extracts, vinasse and nutritive salts, one dilutes it to 14° Balling and after inoculating it with clear must at 50° or 60°, ~~clear must~~ acidification is allowed to proceed. When the desired degree of acidity is obtained, it is set to ferment directly.

For the success of the preparation it is important to filter carefully so as to clear the molasses from the very fine impurities which are in suspension. It is advantageous to allow the filtration to take place without over-pressure and to give to the molasses a large surface of contact with the filter.

The impurities in suspension are in such a state of division that they pass through the closest filter when filtration is effected under pressure. Under these conditions the process becomes less efficacious or even is no longer efficacious at all. By allowing filtration to proceed slowly, without pressure, one is sure of avoiding the drawback pointed out above. In order to offset the slow rate of filtration when it is carried out without pressure, it is well to employ large filtering surfaces.

A filter meeting these requirements is the Kasalovsky filter.

After precipitating the suspended matter, the molasses is run directly into the Kasalovsky filter. The liquid passes through the surface of the filter while leaving the solid substances in the different compartments and comes out of the latter at the upper end. When one of these compartments, each of which operates independently, yields by accident a badly filtered liquid, the corresponding valve is closed. For greater safety a second filter is added or all the liquid is run a second time through the filter which holds back the last impurities.

Filters meeting the requirements demanded in the present case (the Kasalovsky filter for example) are already being used in the sugar industry, but their function then is to retain the lime coming from the clarification and saturation. In the manufacture of molasses yeast, the impurities are elements which existed in the molasses in the colloidal state and which must be eliminated in order to supply a pure and sound nutritive substance to the yeast. A few centimeters of substances in suspension in the must would be sufficient to spoil all the yeast obtained from the must.

RESUME

1. This process for preparing molasses yeast is characterized by the fact that the molasses solution, diluted and acidified in the ordinary way and drawn off clear after boiling, is diluted again and acidified so that by agitating or aerating the solution, the very fine substances in suspension separate, and that the precipitated impurities are eliminated by filtration.

2. One mode of carrying the process into practice while using mineral acids exclusively, is characterized by the fact that the limpid solution obtained by filtration is contacted, without filtration, with malt ~~germs~~ sprouts

directly in the fermentation vat or, for the purpose of introducing nitrogenous elements, it is mixed with clear extracts or nutritive salts.

3. Another mode of carrying it into practice, in which the formation of the lactic acid is effected by the bacterial method, is characterized in that the clear and filtered molasses solution, with which clear nitrogenous extracts have been mixed and to which has been added a starter in the form of clear must has been added, is subjected to acidification for some time whereupon, as soon as the desired degree of acidity is reached, it is subjected to fermentation.

4. The very fine impurities which are held in suspension in the molasses solution are eliminated by filtration on large filtering surfaces in the absence of pressure.

9778.1

SWISS CONFEDERACY

FEDERAL OFFICE FOR INTELLECTUAL PROPERTY

PATENT SPECIFICATION

No. 65,539 CLASS 33 a

May 27, 1913 7 p. m.

PRINCIPAL PATENT

ALFRED POLLAK, THE ALFORT FIRMS,
IN THE OUTSKIRTS OF PARIS (FRANCE)

PROCESS OF ACIDIFYING FERMENTING SUBSTRATES
BY THE USE OF
AMMONIUM COMPOUNDS

In a plurality of processes of the fermenting industry a natural acidification is produced in the fermenting substrate, for example, in the mash in order to increase the fitness of the liquid, for example, for the subsequent alcoholic fermentation by means of

yeast. The acid formation, however, stops at a degree of acidity dependent upon the temperature and the kind of acid bacterium. If it be desired to push this formation of acid further and also to impart greater intensity to the physiological processes taking place at the same time, the already existing acid concentration which interferes with the fermentation, must be reduced by neutralizing by means of an alkali.

True enough, it is already known to add ammonium compounds, e. g., ammonium carbonate, to the fermenting substrates for increasing the nitrogen content of the fermenting substrates. As a result of the addi- soluble tion, ∧ salts of the acid formed by the fermentation are produced which not only promote the often necessary diastase effects in the processes under consideration, but also constitute excellent nitrogen-supplying nutrient salts for the growing yeast. It is however, new to use the ammonia compounds, e. g., ammonia or strongly alkaline ammonium compounds for instance, in a manner such that they are repeatedly added to the fermenting substrates with the object of neutralization repeated partial ~~saturation~~ of the acid resulting from the fermentation. It is an advantage of this process that far more acid is produced than in the former processes and that there results a correspondingly greater amount of soluble ammonium salt and pressable yeast, the former acting as an yeast nourishing and stimulating agent during the manufacture of alcohol for instance.

EXAMPLE 1:

To a mash prepared from any kind of raw material is mixed a pure culture of acid-forming bacteria, whereupon it is subjected to acidification at a suitably high temperature. When the acid formation has

reached a maximum, a test sample of the mash is titrated in the laboratory with alkali to the point of neutrality against a definitely selected indicator, with phenolphthalein for instance. The quantity consumed for neutralization is recalculated with respect to the entire mash, and to the latter is thereupon added so much ammonia that the amount thereof is sufficient for neutralizing ½-¾ of the amount of acid present. In this partly neutralized mash the acid-forming bacterium continues its work until the maximum of acid that can be attained thereby is attained once more. Thereafter the process of neutralization is repeated a number of times until even the increasing salt concentration causes the fermentation process to come to a stop. In this manner however, the formation of acid can be pushed to the quadruple of the former degree of acidity.

As neutralizing agents may be used ammonia, ammonium carbonate, salt of hartshorn, ammonium carbamate or hexamethylenetetramine. The latter of course will be prepared prior to its use most simply by mixing ammonia and a formaldehyde solution.

EXAMPLE 2.

A mash is acidified just as in the preceding example, except that prior to the neutralization of the acid by means of ammonia the mash is divided into two parts, one part of which is neutralized completely, and then admixed with the non-neutralized part which constitutes ½ to ¼ of the entire quantity. In this manner the operation is rendered safer, and impairment of the fermenting power of the acid-forming bacterium by over-neutralization is prevented. The mash thus prepared can then be used for the production of yeast or spirits.

Instead of the mash a solution of sugar or other fermentable substrate of low or high concentration can

be taken and the aforedescribed enrichment in acid be performed therein. Products obtained in this manner can advantageously be used as adjuvants for fermentations of any description, for example, as an auxiliary in baking.

PATENT CLAIM

Process of acidifying fermenting substrates by using ammonium compounds, characterized by this, that the latter are repeatedly added to the fermenting substrates for repeated partial neutralization of the acid resulting from the fermentation.

TRANSLATION OF FRITSCHE AUSTRIAN PATENT.

Austrian Privilege No. 45/4047
Innovations relating to the production of alcohol and pressed yeast.
Gustav Fritsche, Distillery Technician in Strzebowitz near Schönbrunn (Austrian Silesia)

granted on ..... Oct. 26, 1895
Priority of ..... Oct. 16, 1895
Expires ..... Oct. 6, 1900

The innovations forming the subject matter of the present invention relate to the use of ammonium salts, particularly ammonium sulphate, for the production of pressed yeast and alcohol, and have for their purpose to bring about a multiplication of the yeast cells, respectively a higher activity of the diastase.

Ammonium salts, particularly ammonium sulphate, serve as nutrients for the yeast cells and, when added to the pressed-yeast mash, thereby bring about a remarkable multiplication of the yeast cells. The utilization of ammonium sulphate promotes the activity of diastase in grain and potato mashes and effects an increase in yield in their case as well as in that of molasses mashes and sugar solutions.

According to the invention ammonium sulfate in an amount equal to a certain percentage (for example 0.5-1.0%) of the weight of the grain to be processed, is added to the cold water required for mashing corn or rye in pressed yeast manufacture. Depending on local conditions, the amount of ammonium sulphate to be added may even go up to 2% if the yield figures or the cost of production will allow to do so.

This mashing operation is carried out a few hours before the maize is boiled, so that at the same time a quicker and more complete solubilization of the latter is effected. Solubilization having thus been effected the mass of boiled corn is cooled down to 53-55°R. and mixed with the rye and malt, likewise steeped in water. This causes the temperature of the entire grain mixture to drop to about 40°R. and after proper commingling the mixture must once more be raised to the saccharification temperature of 50-51°R., this being effected by the admission of steam during which the mash must be maintained in a state of continuous rotary motion by the agitator.

The rest of the process remains the same as that in use for the production of pressed yeast. The result of the utilization of ammonium salts, particularly ammonium sulphate, is an increase in yield of the most durable and powerful pressed yeast. With the spent-wash process the yield is increased by 2½-3½%, with the ordinary process by 7 to 11 or 12%.

The ammonium salts, particularly ammonium sulphate, are used in the same way for the manufacture of artificial yeast. The amount of ammonium sulphate to be added is best calculated in terms of % of the capacity of the yeast fermentation vats. As a rule it is appropriate to take 0,4-0,6% of the latter. If, for example, the yeast-fermentation vat has a capacity of 300 liters, 1,2-1,8 kg. of ammonium sulphate would suffice in most cases.

A few hours before the so-called "pitching of the yeast" the ammonium sulphate is added to the mash or to the yeast product obtained by peptonization by means of hydrochloric acid. This addition of ammonium sulphate is an excellent nutrient for the yeast cells, which multiply considerably so that a much more intensely acting ferment is obtained which is capable of effecting a more complete conversion of the sugar into alcohol and which enables a higher yield to be obtained. The ferment produced in this way is equally well adapted for any kind of mash.

The ammonium sulphate promotes the activity of the diastase during the conversion of starch substances into sugar and is therefore utilizable with great advantage for the production of alcohol from starchy materials. For this purpose 0,25% to 0,50% of the amount of grain to be processed suffice to increase the yield of alcohol by 5%, frequently even by 8%.

The novelty of the subject matter of the privilege resides in the following:

1. In the production of pressed yeast or artificial yeast used for effecting alcoholic ferementation in the production of alcohol, the addition of ammonium salts, particularly ammonium sulphate, to the water used for mashing starchy substances for the purpose of obtaining an increased yield of yeast having good keeping qualities and a high rising power by means of these salts serving as nutrients for the yeast cells.

2. In the production of alcohol from starchy materials the addition of ammonium salts, particularly ammonium sulphate to the mash, for the purpose of intensifying the starch-saccharifying action of the diastase.

XVII.—BREWING, WINES, SPIRITS, ETC.

Yeast; Development of ——, in Sugar Solutions without Fermentation. Iwanowski, Centr. Bl. f. Bakter, u. Parasitenk, 10, (2), 151-154. Chem. (Centr., 1903, 1, (15), 890.)

The author has previously found that (1) the higher the concentration of nitrogenous substances (peptones) the weaker is the fermentation; (2) the higher the concentration of sugar in the nutrient solution, the stronger is the alcoholic fermentation; (3) in solutions which contain about 0.5 per cent of sugar and about double that quantity of peptone, hardly any alcoholic fermentation is to be observed. In view of Richter's statements (this Journal, 1902, 1239), the author has repeated the experiments which led him to the above conclusions, and he reiterates his statement that in solutions rich in nitrogenous substances, yeast loses in a high degree the character of a fermenting organism, whilst, on the other hand, its reproductive power becomes greater, notwithstanding access of air, and other experimental conditions remain the same. The influence of the concentration of sugar was also examined, and it was found that yeast can assimilate sugar without causing alcoholic ferementation. The free access of air is, however, not alone sufficient to bring about this state of affairs; it is also necessary to have a nutrient solution of suitable composition. The author considers that Pasteur's theory of the relations between alcoholic fermentation and oxygen must be extended in accordance with the above facts.

—A. S."

May 30, 1903, Journal and Patent Literature— Cl. XVI &XVII. p. 643.

XVII.—BREWING, WINES, SPIRITS, ETC.

Yeasts: Influence of meal and other nitrogenous materials, salts and acids on the life and fermenting power of ..... in distilled water with sucrose and in worts. W. Henneberg. Woch. f. Brau., 1908, 25, 77-81, 99-104-118-123, 138-141, 161-164.

The author has carried out an extensive series of experiments which show that rye or wheat-meal, egg albumin peptone, lecithin and inorganic ammonium salts exhibit striking similarities in their action on yeasts. These substances are: (1) non-poisonous to yeasts in pure, distilled water; (2) more or less poisonous in distilled water in presence of sucrose; (3) non-poisonous in supply water; (4) non-poisonous in sucrose solutions, if calcium salts, carbonates or bases are present in small amounts or other salts (such as acid potassium phosphate, magnesium sulphate, sodium sulphide, sodium formate or potassium sulphate) in higher concentrations; (5) of great nutritive value in presence of the substances mentioned under (4). Further, rye or wheat-meal, egg albumin, peptone, ammonium citrate and ammonium oxalate have a much more powerful poisonous action on bottom-fermenting beer yeasts than on top-fermenting distillery yeasts; this is also the case with lecithin, though in a less marked degree. The inorganic ammonium salts have an approximately equal poisonous action on both kinds of yeast. Under ordinary conditions, these nitrogenous substances form excellent nutrient materials for yeasts, their injurious action only appearing in the absence of certain salts, which are more especially compounds capable of neutralizing acids. The other salts able to annul this injurious action of the nitrogenous substances comprise all the calcium salts with the exception of the oxalate and, in much greater concentrations, magnesium sulphate, ammonium sulphate, potassium

phosphate, etc.; the experiments show that calcium and certain other salts are capable of acting to some extent, on acids in such a way as to render them less harmful to the yeast. It must, therefore, be assumed that the nitrogenous compounds give rise, in the interior of the cells, to free acids, which, under normal conditions, are immediately rendered innocuous by the above-mentioned salts; if such salts are lacking, the acids exert a poisonous action on the cells. In the case of ammonium salts, these must undergo decomposition in order to take part in the formation of proteins, the acid of the ammonium salt being liberated; if, therefore, this acid has a poisonous action on yeast, the corresponding ammonium salt will have a similar action. Similarly, lecithin owes its poisonous action to the phosphoric acid set free. Experiments on the length of time required by the different nitrogenous substances to act on yeast, show that the soluble proteins are the most rapidly assimilated and decomposed by the yeast, the action being slower for ammonium salts; the rapidity with which yeast dies under the action of rye or wheat-meal is possibly due to the large quantities of nuclein substances present. Distillery yeasts are considerably more resistant to the action of acids than are bottom fermenting beer yeasts. The remarkable fact that small quantities of ammonium salts exert a greater injurious effect than larger quantities is possibly due to the more rapid assimilation of the smaller amounts by the yeast cells; perhaps also the harmful action of distilled water is reduced when larger quantities of salts are present. —T. H. P.

of the mash rises to 31° and may even go up to 34° or 35°C. Spirit distillers should pitch as low as possible and take care that the temperature rise during fermentation does not pass beyond 30°C. As regards the quantity of yeast to use the rule applies: If much seed yeast is used the yeast crop will be smaller, but the fermentation will be the sooner ended.

Souring With Mineral Acids.

The lactic acid process can be dispensed with in favor of the direct addition of sulphuric, phosphoric, oxalic, tartaric, technical lactic acid, hydrofluoric acid or its salts, or sulphurous acid. In making use of these acids the souring room and its inconveniences become unnecessary, that is, the operation of the factory becomes simplified. In general all the well known methods of preparing seed yeast are about equal in value, provided they are applied and carried out with the necessary attention. In passing from the one method to the other, the distiller may notice that his yields, when he is working with a given kind of raw material, may either be increased, or may remain the same, or may fall off. The question as to which process should be adopted should be decided in view of the equipment of the distillery and general convenience in operation.

Instead of a mash prepared from malt or other grains, use is often made of malt sprouts, or living or dried beer yeast, as yeast food, with or without addition of other mineral yeast foods like phosphoric acid or its salts. For purposes of sterilization the malt sprouts are either heated with the yeast mash, or, what is better, they are put to soak the day before use with sulphuric acid. For every 25 gallons of yeast mash we take two pounds of malt sprouts, and the mash is acidified by the addition of 80 or 130 cubic centimeters of concentrated sulphuric acid which has been previously diluted with six or seven times its volume of water. The malt sprouts may be allowed to soak in this mixture for from 24 to 72 hours; during this time the bacteria adhering to the malt sprouts will be killed and the sour liquid will dissolve as much albuminous substance as could be obtained from dried beer yeast.

One of the chief errors of practical men is to anticipate the effect of an unusual increase in the acidity of a sour mash by the addition of more acid without taking the trouble to ascertain the cause of the increase. Often the yeast is seriously weakened by the addition of too much acid; this means too much acid in the main mash also, and the result is a diminished yield of alcohol. Where this occurs the yeast must be replaced by fresh pitching yeast. To bring a weakened yeast again into a vigorous condition is a more expensive and time-consuming operation than to procure a new mother yeast. If, however, the yeast is a specially good one, and has not become too much weakened or impure, it is worth while to refresh it.

The normal amounts of acid specified in the newer processes of Buechler and others assure a medium or average yield, but the distiller or yeast manufacturer should from time to time make a special test to ascertain the most favorable degree of acidity for the raw materials he is using. Every 0.1 degree of acidity above the optimum has an unfavorable effect on the alcohol yield. The fermentation in the main mash is perceptibly weakened and delayed when there is as much as 0.3 or 0.4 degrees of sulphuric acid. In making a sour yeast mash with sulphuric acid, no more than 1.3 degrees of this acid should be used; above this limit the yeast suffers a decrease of activity. When the activity is 1.8 or 2.0 degrees, the weaker yeast cells die off and even the stronger cells live only 24 or 48 hours unless immediately brought into the prepared sweet main mash, where they multiply and again begin a vigorous fermentation. Two or three degrees of acid are eventually fatal to the yeast.

Yeast of itself produces considerably less acid in acid media than in neutral media, and in this respect resembles the acid producing bacteria. Unless this point is regarded mistakes may easily be made.

One may work according to the Wilfert or other sulphuric acid methods which specify from 0.8 to 3.6 degrees of acidity, but these methods are uncertain and full of trouble.

If one is working with a pure yeast, the aim should be to work with as little acid as possible, and resort to purifying the yeast with sulphuric acid only occasionally. If the yeast is not free from bacteria the distiller may begin with 1.0 or 1.3 degrees of acidity and gradually decrease it. One may also proceed by adding 2.0 to 2.5 degrees of acidity to the pitching yeast and allow to stand for half an hour.

There are some yeast makers who add as much as 6.0 degrees of acid to their yeast mashes, but in such cases they must add the yeast mash to the main mash within 10 minutes or the yeast will perish. Some yeast makers use hydrochloric acid to the extent of 2.2 degrees, allowing two hours as the minimum time for the acid to act.

The Distillation of Final Molasses

By PROFESSOR WM. L. OWEN.

Bacteriologist Sugar Experiment Station, Louisiana State University.

CHAPTER V.

Sluggish Fermentations of Molasses; Their Causes and Means for Their Prevention.

When operating a distillery under the seventy-two hour law, which applies to all such industries throughout this country, any tendency toward sluggishness of fermentation can only result in a de-

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mentation. As wines are usually poor in nitrogen, there is added as nutrient for the yeast about 20 gr. of ammonium chloride, which is completely consumed by the yeast.

Thus it is apparent that by the employment of pure culture as contrasted with the old method of spontaneous fermentation, very significant advantages may be secured, of which the most important undoubtedly is, that the wine producer has, so to speak, the fermentation in his hand, and is not dependent upon the hap-hazard results of accident and chance. There is, accordingly, not the slightest doubt that the utilization of pure yeast, as has been introduced into the brewery long ago, is also in the production of wine destined to bring about a complete revolution.

DR. W. DONSELT.

On the Influence of Flour and other Nitrogenous Substances, Salts, and Acids on the Duration of Life and Fermentative Power of Yeasts in Distilled Water with Saccharose, and in Worts.

UNDER this title, W. Henneberg has published his reports of investigations made in the technico-scientific laboratory of the Institute for Fermentation Industries in Berlin. In No. 10 of the "Wochenschrift fuer Brauerei", current volume, he summarizes the results of his exhaustive investigations in the following conclusions, which are unquestionably of great interest:

CONCLUSIONS.

From the reported results of investigations it is apparent, that flour, egg albumen, pepton, lecithin and inorganic ammoniacal salts in their influence upon yeast, exhibit striking resemblances, which above all, show themselves in the following particulars:

1. Not "poisonous" or "toxic" in pure distilled water.
2. More or less "toxic" in distilled water with sugar infusion.
3. Not toxic in hydrant water (of the Institute) with sugar.
4. Not toxic, as soon as lime salts, carbonates or bases are present in the sugar solution in very slight amount, or other salts in greater concentration.
5. In the presence of these substances they are mostly of excellent nutritive value.

6. Flour, egg albumen, pepton, citrate and oxalate of ammonia, kill off the under-fermenting beer yeast in much more vigorous degree than they do the top-fermenting distillery-yeast; with lecithin this is likewise the case, though the phenomenon here is not so clearly apparent. Only the case, though the phenomenon here is not so clearly apparent. Only the inorganic ammoniacal salts are poisonous for both yeasts in approximately the same degree.

From the chemico-physiological point of view the above mentioned substances have this in common, that they are all nitrogen compounds, which have long been known as excellent yeast nutrients under ordinary conditions. The assumption is, therefore, probably valid, that they all exercise an injurious effect in the same manner and for the same reason, as soon as certain salts are lacking.

If, in order more exactly to establish the cause of their toxicity or injuriousness, we examine the kind of substance necessary to render them innocuous, we notice, that they are, above all, acid-destroying substances, viz., bases and carbonates.

We may, however, further classify among these all the lime salts—with the exception of the oxalate of lime—and so far as observations have gone, in much greater concentration, magnesium sulphate, ammonium sulphate, potassium phosphate, etc. Do these also operate upon acids within certain limits, so that they are not at all, or only slightly injurious in effect? So far as experiments have up to this time been carried out, this has been definitely established in the case of lime salts, and likewise for several other salts.

We must therefore assume, that in the process of conversion of the nitrogen compounds named, free acids are generated in the interior of the cell, which are normally rendered innocuous imediately by the salts just mentioned. If the salts are lacking, the acids may be deadly in their effect (c. f. address of the author before the October Meeting, 1907, 1907 Volume, Page 638—650).

The conditions in the case of ammonium salts are very simple. The yeast, as is well known, may with great advantage use them for its production of albumen. For this purpose, it must of course split them up. The acid which has been in combination with the ammonia is thus liberated. If the latter is carbonic acid, no poison develops. If they are only slightly injurious organic acids, they may be rendered innocuous by combustion. Citric and oxalic ammonia salts have a poisonous effect on beer yeast, because these acids are extremely toxic for this yeast. For the same reason, the inorganic ammoniacal salts, with the exception of the carbonate of ammonium, are extremely poisonous in effect.

A similar explanation might be given of the toxicity of lecithin. The yeast in this case probably dies off because of the phosphoric acid being liberated.

In the splitting up of pepton, ovalbumen and flour, besides various organic acids, oxalic acid, sulphuric acid and phosphoric acid might arise. As lime salts not only render oxalic acid innocuous, but exercise this same effect on sulphuric acid, phosphoric acid and other acids, there is no way of determining in each individual case, which of these acids is in question before us. Against its being oxalic acid, there speaks to a certain extent the fact, that in spite of many experiments where a subsequent lime infusion, etc., was made, only very rarely could oxalate crystals be observed in the interior of the yeast cell. Probably in some cases (flour) phosphoric acid developes besides organic acids, and in others (pepton), sulphuric acid. It probably cannot be determined by chemical analysis, for naturally only very minute quantities come into question, which possibly do not force their way out of the cell at all.

If we observe the period of time during which the substances exert their influence, it becomes particularly striking, that the flour operates injuriously most rapidly of all, pepton and ovalbumen somewhat less quickly, and the inorganic ammoniacal salts only after several hours. In this very order, we probably have before us the order of succession of the utility (assimilation) of these nitrogen compounds for the yeast; the soluble albumen compounds are taken up by the yeast and decomposed with the greatest rapidity, and the ammonium compounds more slowly. Possibly the prolific quantities of the nuclein materials of the flour are also at the same time the cause of the rapid dying off of the yeast.

A difference between distillery yeast and bottom-fermenting beer yeast is in most cases clearly apparent under the influence exerted by flour, ovalbumen, and pepton, in that only the bottom-fermenting beer yeast is destroyed. Inorganic ammonium salts kill both, though to be sure after some hours only. Citrate of ammonium destroys beer yeast more than it does distillery yeast. Oxalate of ammonium only destroys beer yeast! Through many comparative experiments, the fact was definitively proved, that distillery yeast possesses a considerably greater power of resistance against acids (sulphuric acid, phosphoric acid, etc.) than does the bottom-fermenting beer yeast. Against some acids such as acetic acid, butyric acid, valerian acid, and oxalic acid, distillery yeast is conspicuously more capable of resistance, and against tartaric acid and citric acid, has much greater power of resistance, than beer yeast. If it is certain, that in the albumen decomposition in the organism, acetic acid, butyric acid, valerianic acid, oxalic acid, etc. are also generated, that is to say, acids

to which the bottom-fermenting beer yeast is very susceptible, and against which the distillery yeast offers great resistance, the difference in their behavior toward flour, pepton and egg albumen would be easily explainable. From the fact that the inorganic ammonium salts are equally poisonous for both yeasts, we could also conclude with some probability, that the question is solely, or at least very prominently, one of organic acids in the decomposition of albumen, which accounts for the differences in the behavior of beer yeast and distillery yeast.

Flour, ovalbumen and pepton are deadly only in the beginning upon beer yeast; indeed later on, they exercise a stimulating influence upon the surviving cells. Ammoniacal salts on the other hand, only begin to have an injurious effect after some time of operation, but then, however, it is permanent. We can only explain this by assuming, that the ash content of the first mentioned substances, by decomposition for example, gradually gets into solution or into some other suitable form in which it may then be taken up by the yeast cell. A great deal of pepton is therefore, not as "poisonous" as only a little pepton. From the dead cells materials are also gradually excreted, which are consumed by the surviving cells.

The very remarkable observation, that small quantities of ammoniacal salts have a more injurious effect that definite larger quantities may possibly be explained by the fact, that the yeast cell takes up the former more easily than it does the latter. Moreover through greater quantities the injurious effect of the distilled water itself is possibly more fully restricted. In this latter way we may probably also be able to explain the fact, that many salts in considerable concentration, may pretty strongly diminish the effect of the operation of flour.

As was shown in the author's earlier investigations on nutrient solutions (Wochenschrift fuer Brauerei, No. 40 to 45), acid ammonium salt solutions with the other necessary nutrient salts are extremely unfavorable for bottom-fermenting beer yeasts and moderately unfavorable for distillery yeasts. As soon, however, as chalk, soda, or lactate or phosphate of lime is added, these solutions in all cases become very favorable, whereas gypsum and calcium chloride infusions exercise only a moderately good influence upon bottom- and top-fermenting beer yeasts, and upon distillery yeasts no noticeable influence at all. Inorganic ammoniacal salts without lime salts or bases are, therefore, injurious.

Pepton always operates favorably in nutrient solutions, and likewise when it is added to the wort. Possibly only a slight amount of acid is generated from the pepton. It would thus be explainable, that the injurious effect of pepton in sacchariferous distilled water very soon disappears again.

Flour operates very unfavorably upon bottom-fermenting beer yeast in worts that are concentrated and diluted with distilled water. The necessary lime salts are also here lacking, as the effect disappears immediately upon the addition of lime salts. Gradually, however, the surviving cells begin to sprout very prolifically and very vigorously to ferment. We may, perhaps, here also assume, that the lime salts from the flour, are not at first, but only later after solution and conversion, at the disposal of the yeast cells and that from the many dead cells salts are also lixiviated, which are taken up by the living cells.

How now shall we explain the phenomenon, that chalk, soda and in fact basic substances, so very strikingly delay the death of yeast cells in worts (without further infusions)? The acid of the wort was considered heretofore as obstructive of development and injurious for innumerable varieties of bacteria only. It unquestionably also so operates, even though in much slighter degree, upon yeast. The acids, which develop as products of assimilation of the yeast, will likewise exercise an unfavorable influence.

The fact that the flocculation of the beer yeast and, connected therewith, the clarification of the wort, is better and makes its appearance more quickly if the substances named are added to the wort, is accounted for in the first instance by the fact, that the acid of the wort has become diminished. Lime salts (also organic) have quite commonly a favorable effect also upon the slime development of the beer yeast; perhaps this is also the case with sodium salts.

The yeast cells in saccharose solutions in distilled water, die off to the extent of half and more, after 24 hours. All the materials which suspend the effectiveness of the flour, etc., here also prevent the annihilation. We undoubtedly have before us here the same phenomenon, only that the yeast decomposes its own voluminously stored up albumen, and from this permits acids to generate. At this occasion, fusel oil, as Ehrlich assumes, is also generated through the decomposition of the amino-acids.

Nutrient solutions with ammonium-nitrogen are apparently always characterized by their fusel oil content, (so far as we may conclude from their odor). Experiments have still to determine, whether fusel oil is actually present in these cases in prolific amount. Possibly we have here another important contribution to the explanation of the formation of fusel oil.

It may be remarked in this immediate connection, that the yeast, as we could observe, was very easily able in characteristic manner, to decompose inorganic salts also. As is well known, sulphurretted hydrogen developes from magnesium sulphate in considerable quantities, in

nutrient solutions. We moreover observed the formation of sulphurretted hydrogen from potassium sulphate, calcium sulphate, ammonium sulphate, calcium sulphite, as well as from gypsum in the presence of sulphuric acid.

From both ferous prussiates of potash and nitro-prussiate of soda, yeast is able to liberate hydrocyanic acid.

Berlin White Beer.

BERLIN white-beer (Weissbier), a top-fermented beer, has been known for centuries, and is brewed in Berlin as a specially characteristic variety of beer, out of wheat- and barley-malt. Since the sixties of the last century, a beer has been brewed very similar to that produced to-day, whereas in the production of the old white-beer a smoked wheat-malt was employed, this custom being due to the fact that at that time, the smoky taste of the beer was extremely popular.

Berlin white-beer, as we have said, is a top-fermented beer, whereas Munich, etc., are bottom-fermented beers. After the fermentation, two different courses may be pursued in the method of procedure for the preparation of the beer. In the first part of the operation, namely until the middle of the fermentation period, a common course is followed. Whereas in the bottom-fermentation process, the yeast in the beer gradually settles at the bottom in a solid layer, being then removed from the vat after completed fermentation, subsequent to racking of the beer into the storage tanks, the procedure in the other manner of fermentation, the top-fermentation, is so carried on, that the yeast cells, engaged in the most vigorous fermentative activity, are drawn toward the top, and at the surface of the beer, form a tough, white, and quite consistent yeast-layer.

About one-fifth of all the beers brewed in Germany, are brewed under top-fermentation; these are Graetzer beer, Gose, Lichtenheimer, Berlin Weissbier and many others. In England this group is increased by the characteristic English beers, as porter and ale. All our lager-beers, on the other hand, are bottom-fermented. The yeast race is the determining factor of a top-or bottom-fermented beer, depending upon whether a top-fermenting or bottom-fermenting yeast is added.

Berlin white-beer is a peculiar and quite characteristic variety of top-fermented beers. In its production, wheat- and barley-malt are

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TRANSLATION OF PAGE 562

From: Centralblatt f. Bakt. etc. 1914 an article entitled "The Nitrogen Nutrition of Mold Fungi", starting on Page 555.

As shown by Czapek (I), salts of hydroxylamine and hydrazine can serve as N-sources, although only in case of necessity.

For the purpose of clarifying the question as to whether amino acids and amides can be directly assimilated or whether their decomposition into acids and NH_3 must first take place, and also in order to learn the connection between the working of these compounds and the production of oxalic acid, the writer has prepared numerous cultures. In most of these solutions he found NH_3 even in the presence of an abundance of sugar as the source of C and from this he concludes that deamidization precedes assimilation. He could find no connection between the N-assimilation from amino acids and the formation of oxalic acid. As regards the importance of amino-acids for the synthesis of the proteins Raciborski accordingly takes a different standpoint from that of Czapek inasmuch as he denies direct applicability to them in the synthesis.

As was to be seen from the foregoing, aspergillus niger or some perisporiceae closely related to it was used as the object of the investigation. The chapter in O. Hagems "Researches on Norwegian Mucorineae" which deals with the N-resorption of these fungi, is therefore of great interest. His careful, extensive investigations deal mostly with N-compounds, of which it can be assumed that they play a role in the life of the mucorineae in nature.

Nitrite and nitrate can be utilized by a limited number of species. Owing to their capability of reduction to NH_3, HNO_2 and NH_3 can mostly be detected as reduction products of nitrates, NH_3 as the reduction

products of nitrites. The reduction to NH_3 is to be regarded as an intracellular phenomenon.

Inorganic NH_4 salts are good sources of N (nitrogen), provided the accumulation of free mineral acid is prevented by the addition of $caCO_3$. NH_4NO_3 occupies an exceptional position with respect to those species which reduce nitrate. Both the NH_4 and the NO_3 ions are utilized by them about equally quickly.

To the extent as organic NH_4 salts have been tested, they constituted an excellent N-nutriment. Urea is worked up by all the species investigated. They produce varying, and often quite considerable, quantities of $(NH_4)_2CO_3$. Acetamid has an insignificant value as a nutriment or none at all. Uric acid is used with success. The separation of NH_3 could not be ascertained with certainty, but it probably takes place nevertheless. Amino-acids are very good sources of N in the presence of sugar. In all culture liquids NH_3 was detected in varying amounts. The same applies to peptone, which besides can be used with advantage as a source of C (carbon).

Hippuric acid is worked up by a relatively small number of species. It splits up into benzoic acid and glycocoll, and the latter compound is further broken down with formation of large amounts of NH_3.

As can be seen, the separation of NH_3 accompanies the assimilation of N almost without exception. From this the writer draws the conclusion, which has been already pointed out by Raciborski and other writers with regard to the working up of amino-acids by aspergillus, that "the fungi must form ammonia in any nitrogen resorption and are able to begin their protein synthesis only from the former as a starting point".

9778.

A. WILFERT

PRESSHEFE, KUNSTHEFE UND BACKPULVER
VIENNA, 1890, 2nd Ed. pp. 192-195 incl.

The (proper) quantity of water is placed in a special vessel (water at ordinary temperature is used) and the weighed amount of sulphuric acid is poured in a thin jet into the water which is vigorously stirred with a wooden stick during the pouring. In consequence of the chemical combination into which the sulphuric acid enters with the water, the whole liquid is heated so strongly by the liberated heat that it begins to give off steam.

Let it be expressly stated here that the sulphuric acid must always be poured into the water; if, conversely, the water were poured into the acid, this might have the most dangerous consequences as so much heat would then be set free that part of the liquid would be set into violent ebullition and hot acid be ejected from the vessel. Persons struck by this acid suffer serious injuries. If one works in the way indicated, that is, if the acid is poured into water set in motion, the operation of the two substances is attended with no danger at all.

The mashing of the malt and grain grist with water at 48 to 49° R. is continued until by means of the iodine solution test one has become quite sure that no unchanged starch remains in the liquid. The iodine test consists in adding a few drops of a solution of one part of iodine to 20 parts of alcohol to a small quantity of the mash clarified by filtration and brought to room temperature. As long as the action of the diastase of the malt is incomplete, the liquor will keep on exhibiting a wine-red color; on the other hand, when on addition of the iodine solution the liquid remains colorless, then the mashing operation is to be regarded as finished.

Only then is it permissible to add the sulphuric acid, as the saccharifying action of the diastase on the starch would be disturbed by the premature addition of the acid. The relative proportions of finished mash and sulphuric acid depend on the amount of the material (malt and grain together) used for the preparation of the mash. To every 100 kilograms of material one takes one kilogram of sulphuric acid which is diluted with 5 litres of water, as stated above.

The diluted sulphuric acid is slowly run into the hot mash and most intimately mixed therewith by constant stirring, whereupon the temperature of the entire liquor is allowed to drop to 36° R. and maintained there for three to four hours.

There now takes place in the mash exactly the same reaction which takes place when a mash is subjected to a lactic acid fermentation; the proteins present in the malt and raw grain dissolve and are converted into peptones, and after four hours the starting yeast can be considered to have reached full maturity and the mother yeast is added thereto.

The mash, however, contains a rather large amount of sulphuric acid, and after cooling the mash to 18 to 16° R. this acid would have a disadvantageous influence on the mother yeast which is now to be added; it is therefore necessary to bring the sulphuric acid content of the liquor to a lower figure without it being necessary, however, to separate the sulphuric acid from the liquid.

The sulphuric acid acts disadvantageously on the development of the yeast only when it is present in large amounts; conversely, a small amount of sulphuric acid is highly beneficial for the development of the yeast, as it contributes considerably to the production of a very pure and vigorous yeast. The yeast plant requires for its vigorous growth a liquid which is slightly acid; apart from the fact that this constitution

of the liquid promotes the development of the yeast plant, it renders the development of fission fungi almost entirely impossible, inasmuch as the latter, as experience has shown, can thrive well in neutral and alkaline liquids but cannot develop in acid liquids.

If, therefore, for the mash that moment has arrived where the action of the sulphuric acid on the proteins can be regarded as completed, then according to the usual processes the cooling to 18 to 16° and the addition of the mother yeast would have to be effected; however, it is better to effect no special cooling but to proceed in the following way:

The preparation of the starter treated with sulphuric acid is effected in a vessel capable of holding three to four times as much liquid as the amount of starting yeast to be prepared at one time, and into the finished mash, which still has a temperature of 36°, is run so much sweet mash held at ordinary temperature that the temperature of the mixture drops to 16°, after which the mother yeast is added.

In a mash in which the sulphuric acid content is diluted to that extent, the development of the yeast and the fermentation proceed in a perfectly normal way, and there is no reason to be found for removing the sulphuric acid from the liquor. This can be done in a very simple way by adding to the mash slaked lime—stirred up in water to give a milky fluid—until the acid taste of the mash is scarcely discernible any longer.

The lime combines with the sulphuric acid to form calcium sulphate or gypsum, which compound is only slightly soluble in water and accordingly separates from the liquid in the form of a white powder. After the addition of the lime the liquid must be left undisturbed until the lime has settled out at the bottom, after which the liquor standing above the sediment is carefully drawn off.

As one can convince himself by a comparative test with two lots of the same mash, one of which was neutralized with lime whereas the other was left in the original state, the neutralization has not the slightest influence on the amount of newly-produced yeast nor its fermenting power and for these reasons the neutralization can be omitted entirely.

After the addition of the mother yeast to the sulphuric acid mash, the latter is further processed in the same way as with any other starting yeast; it is allowed to ferment to a definite degree, the newly-produced yeast is . . . .

9778. 93524C

TRANSLATION

Wochenschrift für Brauerei
1903, Jan. 18—20th year—No. 3; p. 25

SOME PRINCIPLES OF YEAST REPRODUCTION

By

M. Delbrück

1. Under similar conditions, particularly with mashes and worts of similar composition, the number of yeast cells in a given volume at the end of the reproductive period is the same.

2. Accordingly, the number of yeast cells sown does not affect the ultimate yield. With a greater number sown, a smaller ~~reproduction~~ multiplication occurs, with a smaller number, sown, a greater ~~reproduction~~ multiplication.

3. The cause of this phenomenon is to be sought in that the yeast cells mutually exert a disturbing influence. Each active yeast cell controls a certain space around it, in which it does not allow a new yeast cell to develop. The specific reason for this phenom-

enon is to be sought in that the excretion products of the yeast are injurious to the yeast itself, and, for that reason, to its neighbors of the same species. There comes into consideration mainly alcohol and carbonic acid, but also fusel oils, protein conversion products, etc. Since most of the carbon dioxide escapes from the liquor, the alcohol remaining in the latter is, for the main part, the controlling factor. In cold fermentations, such as in bottom-fermentation brewing practice, the alcohol content, however, is so small and the carbon dioxide content so high that in the present case the converse happens, e. g., the main role is played by the carbon dioxide. Carbon dioxide is ten times as poisonous to yeast as alcohol.

4. The individual yeast races present different degrees of susceptibility towards alcohol and carbon dioxide; this is the reason why one race stops ~~propagation~~ multiplication earlier, another one later. Of course, other excretion products can also be decisive.

5. The first principle set forth is only valid when the yeast cells or the liquid with the yeast cells is in uniform quiet movement, so that the cells are distributed uniformly throughout the liquid. If a part of the yeast is separated at the top by flotation or a part thereof goes to bottom by sedimentation, then multiplication of the cells remaining distributed in the liquid will be favorably influenced, as space is then available for them. This action will however, occur only until the maximum proportion of alcohol and carbon dioxide content permissible for ~~propagation~~ multiplication has been reached. For they are uniformly distributed in the liquid, their action is not influenced by the ~~separation~~ excretion

of yeast cells. Experiments are not yet available as to whether a larger yeast ~~propagation~~ multiplication can be obtained by the systematic separation of part of the cells already formed.

6. The main experiment, by which the basic law can be proved, consists in that a given volume of liquid is inoculated with different amounts of seed yeast. Microscopic observation shows that with a given slight seeding all the cells bud, and according to the strength of the seed, form one, two or more new cells, that furthermore, with increasing quantities of seed, the budding activity of individual cells is stifled (the strongest individuals ~~propagate~~ multiply) that, finally, with a very large amount of seed (10% of the weight of the liquid in pressed yeast) all the cells fail to bud. This experiment can be easily carried out in the laboratory, it is in agreement however, also with the observations made in practice, both in the worts of breweries and in the acidified culture liquids of distilleries and their main mashes.

7. If dissimilar nutrient liquids are present, then the following changes occur: In very dilute media, the number of cells produced in a given volume is less, owing to deficiency of nutrition. The number of cells increases with the proportion of available nutriment, but only as long as multiplication is not prevented through the accumulation of alcohol. As a rule, 4% of alcohol by weight suffices to put a limit to multiplication. Worts and mashes of a concentration which permits of exceeding this alcohol content, do not give the yeast multiplication corresponding to their nutrient content. To obtain the highest number of cells this alcohol content must not even approximately be formed during the fermentation. Manufacturers of yeast who

operate with worts, have a wort concentration of perhaps 7% on the saccharometer. With increased admission of air, as by using very shallow fermentation vats or by directly injecting air, the multiplication becomes greater. The stimulation of the budding activity by the oxygen of the air is so great that the higher number of cells is already attained before the inhibition due to the accumulation of alcohol sets in.

8. But even motion, particularly the motion in the earlier stages of the fermentation, leads to changes in the number of cells formed. Not only do the excretion substances act upon neighboring cells, but also upon the seed cells themselves. If motion is imparted to the medium, the individual cell itself is carried away from its station; it emerges from the excretion substance present in its immediate vicinity, it strips it off so to speak and reaches places yielding new nourishment which through the ready nutrients stimulate budding.

10. This initial motion can be brought about by an agitator; it can however, also be effected by the number of seed yeast cells and by the mode of this addition. Too small a quantity of seed yeast is the cause of a lessened multiplication, owing to a deficiency of carbon dioxide gas to induce the initial motion. If the addition is effected in such a way that the seed yeast is—to use the technical expression—applied in the form of a preliminary mash, i. e. instead of distributing pressed yeast in the liquid there is added an already fermenting medium pitched with seed yeast, motion will be present right from the start and that for the following reasons.

The given amount of seed yeast, to which a small amount of fermentable liquid has been added, induces at once an active fermentation in the latter and sets it

into motion since cells are present in excess. After the addition of the main liquid this strong motion will be transmitted to the latter, for the reason that all of the cells have already started budding, therefore a stronger fermenting action is present, and, furthermore, because not only have yeast cells been added but also a carbon dioxide-containing liquid. The highest crop therefore is obtained by the continuous process of fermentation according to which there is first placed into a large fermentation vat the inoculating yeast together with a little wort, whereupon a stream of fresh nutrient liquor is run in continuously, distributed over, say 24 hours, until the receptacle is full.

11. The nature and quantity of the excretion products depend also upon the physiological condition of the yeast cells, the ~~reproduction~~ multiplication, therefore, is also dependent on the physiological condition of the seed yeast.

Translation of Franz Lafar, "Handbuch der Technischen Mykologie", Fourth volume, 1905-1907; from page 131, line 10, to page 132, line 33, inclusive.

To hinder or stop fermentative activity, it is necessary to have, under otherwise equivalent conditions, a larger addition of alcohol than that which is able to stop the growth of the yeast cells. Thus a pressed yeast investigated by Hayduck (2) no longer increased in a 7 percent by volume sucrose nutrient solution, although lively fermentation continued. To hinder this also, according to the conclusions of an investigation by Brefeld (1), an alcohol addition of 17.3 percent by volume to the nutrient solution is necessary. On the contrary, in Hayduck's (3) investigation, absence of

fermentation was observed with only 15 percent of alcohol, by volume, in the nutrient solution. V. Peglion (1) found in an Italian wine during its after-fermentation an active yeast which still showed fermentative activity in the presence of 14.3 percent by volume of alcohol in the nutritive substratum. Further facts on the influence of the presence of alcohol on alcoholic fermentation will be found in Chapter 17. With reference to Mycoderma the 14th chapter may be consulted.

Of the other conditions which have a determining influence on the magnitude of alcohol concentration or addition which restricts fermentation, temperature is to be placed in first rank. Inside those limits which can come at all into consideration here, the sensitivity increases with temperature. With it there first increases, from the physical viewpoint, the permeability of the cell wall by means of osmosis for the alcohol tending to enter the cell's interior and, second, from the physiological viewpoint, the lability (ease of change) of the molecular groups of the plasma, as well as the sensitivity of these to outside influences. We owe to H. Müller-Thurgau (1) some facts about this. He found, under the conditions chosen by him for the experiments (that is, the character of the nutrient solution and the kind of strain of yeast) that under like conditions fermentation came to a standstill:

at 36° C. as soon as there was present 3.8 percent by weight of alcohol,
at 27° C. as soon as there was present 7.5 percent by weight of alcohol,
at 18° C. as soon as there was present 8.8 percent by weight of alcohol,
at 9° C. as soon as there was present 9.5 percent by weight of alcohol,

The existence of a relation between the heighth of the temperature and the degree of sensitivity of the yeast to alcohol seems to have been sensed by the old-time practical brewers, since they set down as the fundamental of their fermentation—not only for the making of good beer but for obtaining a strongly-fermenting setting yeast—the rule: Let the temperature in the vat rise at the beginning of the fermentation (when only a little alcohol is present) and then slowly bring it down.

The character of the nutrient solution equally exerts influence on the degree of sensitivity of the yeast to alcohol, therefore (from the viewpoint of fermentation technology), on the highest alcohol content attained by the fermenting liquid. Unfortunately, there are available in this field only a few errorless researches; like, for example, that of Müller-Thurgau (1). These have disclosed that under otherwise equal conditions, the injury caused by alcohol to the cell activity of the yeast increases with increasing sugar content of the nutrient solution. To this circumstance (not really understood in its cause but well known in its effects) there goes back the fundamentals of the process which under the name of Drauflassen ("addition") long has been used in various fermentation industries, especially in molasses distilleries, and has shown itself profitable. In those countries in which the brandy tax is levied entirely or partly on the size of the mash vats or fermentation vats, it is on this ground, to speak of nothing else, in the distiller's interest to mash his vats as thick (that is, sugar-rich) as is practicable. Thus, however, he comes in conflict with the effect of sugar concentration, already mentioned, in increasing the sensitivity of the yeast to alcohol. Here also the ingenious practical man, by many trials, has discerned a way out; he arranges such a

dilution of the molasses to be fermented as is known by experience to let the fermentation go on readily, and then adds thick molasses gradually, in the amount of the sugar that has disappeared. In those other distilleries which do not work on molasses but on unmalted grain (potatoes, Indian corn and the like) this Brauflassen is not very practicable, for reasons not to be discussed here. In brewing, on the other hand, it is not seldom resorted to, especially when the available amount of pitching yeast is insufficient and is to be increased quickly. (See the 6th chapter of the 5th volume.) In the sugar-rich musts used for the preparation of choice wines, which are fermented without the use of the expedient described, the fermentation remains stationary, as a result of the interrelations spoken of, before all the sugar is worked over, and one thus gets wines which actually have ceased to ferment but yet are sweet.

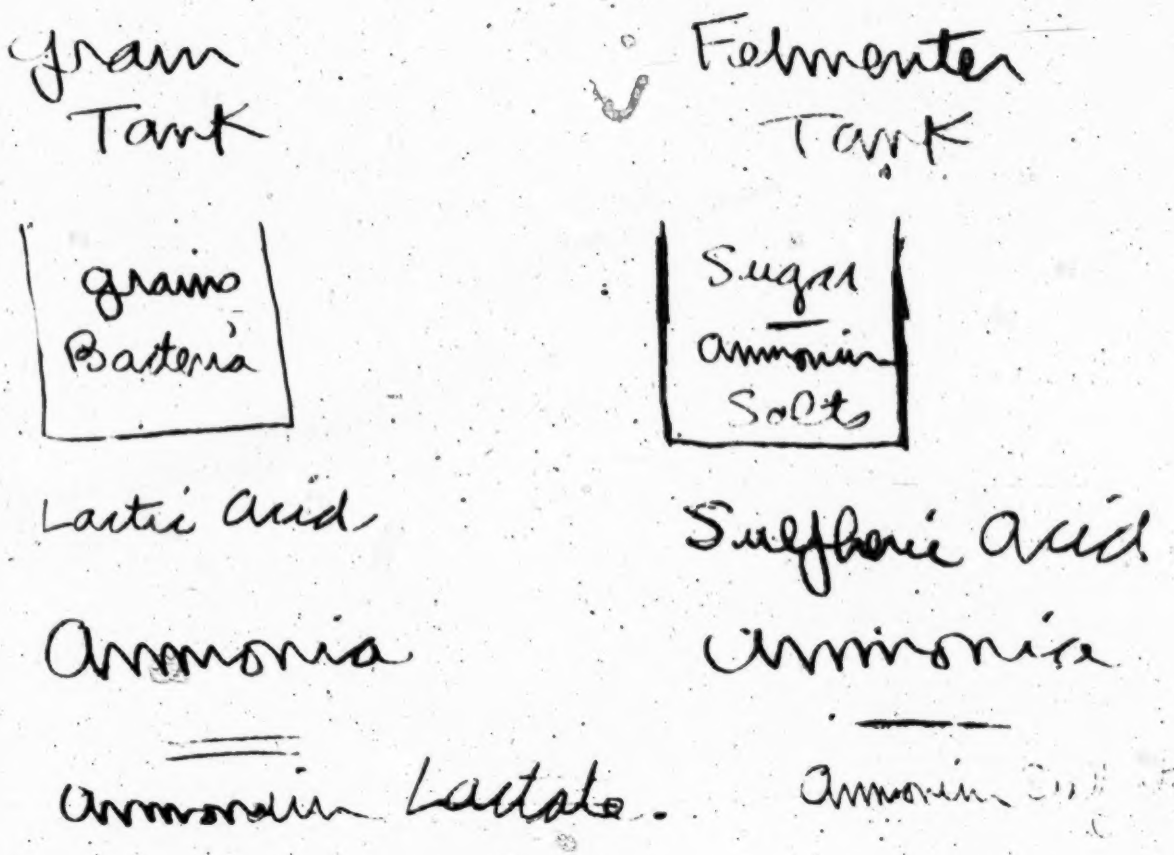
DEFENDANT'S EXHIBIT D-2.

Book Entitled Foreign Patents and Publications.

(Physical Exhibit.)

DEFENDANT'S EXHIBIT D-3.

Sketch of Grain Tank and Fermenter Tank.



Sketch of Grain Tank and Fermenter tank.

DEFENDANT'S EXHIBIT D-4.

Book Containing Records Concerning Experiments 3 and 4 Made May 31, 1935.

(Physical Exhibit.)

DEFENDANT'S EXHIBIT D-5.

Certified Copy of German Application Filed March 15, 1915.

(Translation Only Printed.)

SWORN TRANSLATION FROM GERMAN:

CERTIFICATION.

The photostatic copy attached hereto is a true and correct copy of the specification with claims, which has been filed on March 15th, 1915.

Berlin, this 10th day of March, A. D. 1935.

THE PRESIDENT OF THE REICHSPATENTAMT
(The Commissioner of the Patent Office of the German Reich).
As Substitute:
sgd.
Ellmenreich

L. S.
(RAISED SEAL OF THE PATENT OFFICE OF THE GERMAN REICH).

Pat. 303 251 (V 13 012 IV/6 a)

PROCESS OF MANUFACTURING PRESSED YEAST.

In the case of fermentations in solutions of sugar and salts, which are carried out in accordance with the process under the principal patent, a considerable increase of the acidity takes place in the fermentation liquid during the development of the yeast, without, however, the appearance of any bacteria. The acid thus created,—as has already previously been shown by Professor Dr. W. Henneberg,—is a mineral acid which apparently is produced due to the fact that the basic contents of the salts dissolved are absorbed by the yeast, and that the acid contents of said mineral salts are consequently set free.

Said free mineral acids exercise, as can also be observed by means of a microscopic inspection, a detrimental effect upon the yeast.

By the addition of suitable basic substances which are harmless, as far as the development of the yeast is concerned, as for instance carbonates, this mineral acid can be perfectly neutralised, or the acidity can, at least, be reduced to such a degree that it does no longer harm the yeast cells, whereby the detrimental effects occurring in this process are entirely prevented. Basic substances which are nitrogenous, can also be used. The process can, moreover, be made use of for the fermentation of pure sugar solutions with an admixture of mineral salts, without, however, a yield of yeast thereby being obtained.

Claims:

(1) In the process under the principal patent the neutralisation of the acid mineral substances being set free upon the fermentation, said neutralisation being brought about by means of suitable alkaline mineral salts, such as for instance carbonates.

(2) In the process under claim ONE the use of basic nitrogenous salts.

(3) The use of the process under claim ONE also in the case of such processes of fermentation, where it is not intended to obtain yeast.

DEFENDANT'S EXHIBIT D-6.

Copy of German Patent No. 300,662 of November 12, 1919.

(Translation Only Printed.)

TRANSLATION.

German Patent No. 300,662

Verein der Spiritus Fabrikanten in Deutschland

Issued November 12, 1919—Filed March 17, 1915

"Process for the Production of Yeast Without or With Only Small Production of Alcohol"

In the production of yeast according to the wort aïration process by use of the usual operation considerable quantities of alcohol are obtained the amount of which depending on the amount of sugar which is at the disposal of the yeast. It has been tried to work out suitable processes for the conditions whereby an increase of the yield in yeast from the applied raw materials at the expense of the production of alcohol appears more profitable. It has been suggested, for example, to dilute the worts to such a degree that the alcohol produced from the sugar can again be assimilated as nutrient by the yeast. The same purpose should be obtained by the patent 10,135, Class 6, in such a manner that the nutrients necessary for the yeast (sugar, peptons) are added in portions or continuously according to need and so slowly that the yeast utilizes the sugar not for the formation of alcohol, but only

for the nutrition. Also in this case a very small concentration of sugar, or, in other words, a very far extended dilution is necessary; by the increase of the operation costs connected with this high dilution, however, in both processes the advantage of the high yield of yeast is again partly offset. –

In the process described in the following, forming the matter of the invention, the purpose is obtained of obtaining high yields in yeast without or only with a small production of alcohol by application of worts of normal condition and concentration in such a way that the wort is continuously added to the yeast in such small quantities that it does not form any alcohol in excess, but that it is able to again assimilate it while still forming.

The process is performed, for example, in the following manner:

A wort is produced in the manner as usual in the pressed yeast industry (for example of 12 per cent Balling), a part of the wort is strongly diluted (for example to 1 per cent Balling), yeast is added and then the airation is started in a known manner. The remainder of the concentrated wort is now continuously added in such amounts that not only the alcohol formed from the sugar which was present at the beginning, but also the alcohol which is formed from the sugar which is added together with the wort can at once be assimilated by the yeast. If a total airation of 10 hours is provided the addition is made within 7 to 8 hours with continuous airation, and the airation is continued for 2 to 3 hours without the addition of wort. The quantity of the thin wort which is at the disposal of the yeast at the beginning is, for example, provided in such an amount that the totally applied wort would show an average value of 3 to 5 per cent Balling.

In contradistinction to the process of producing yeast from worts of very small concentration, the

aforementioned process shows the advantage that the yeast is continuously provided with new nutrient by the continuous addition of concentrated wort and that, because of the continuous consumption of the nutrients by the yeast, at the same time, always only such a concentration of the wort is present whereby the nutrients and the continuously formed conversion materials are best and quickest absorbed by the yeast, that means, by the peculiar distribution of the wort the advantages of the great dilution upon normal wort concentration (calculated for the total quantity) are obtained.

In the process according to the patent 10,135 in fact also the periodical or continuous addition of sugar or peptons to the liquid containing the yeast is provided, by utilization of the high dilution which is of advantage for the growth of the yeast at the expense of the formation of alcohol. However, aside from the fact that this process requires a continuous observation of the conditions of the nutrients in the liquid, since sugar and peptons are separately added and only according to demand, the operation with normally concentrated liquids has not been provided; the simple administration of the aforementioned process is therefore missing which does not differ in any way from the normal process of the production of airation yeast in the production of the wort and in the expenditure of work.

The preparation of the first undiluted setting wort with yeast and the addition of the remaining wort which is more and more diluted by the "Nachschwänzen" has been known in the production of pressed yeast. By this operation, which follows the opposite principle, however, such large quantities of alcohol are produced from the very beginning that an assimilation of the alcohol which is worth mentioning cannot arise anymore.

CLAIM:

Process for the production of yeast without or with only a small production of alcohol, characterized in that the cultivation of yeast is started in strongly diluted wort of a known composition and that to the diluted wort a wort of higher concentration is continuously slowly added.

DEFENDANT'S EXHIBIT D-7-1.

Synopses of File Wrapper Contents of United States Patent No. 1,449,103 to Friedrich Hayduck, Dated March 20, 1923.

(Physical Exhibit.)

DEFENDANT'S EXHIBIT D-7-2.

Synopses of File Wrapper Contents of United States Patent No. 1,449,105 to Friedrich Hayduck, Dated March 20, 1923.

(Physical Exhibit.)

DEFENDANT'S EXHIBIT D-7-3.

Synopses of File Wrapper Contents of United States Patent No. 1,449,106 to Friedrich Hayduck, Dated March 20, 1923.

(Physical Exhibit.)

DEFENDANT'S EXHIBIT D-7-4.

Synopses of File Wrapper Contents of United States Patent No. 1,449,109 to Friedrich Hayduck, Dated March 20, 1923.

(Physical Exhibit.)

DEFENDANT'S EXHIBIT D-8-1.

Patented Mar. 20, 1923. 1,449,127

UNITED STATES PATENT OFFICE.

MARTIN NILSSON AND NORMAN S. HARRISON, OF PEEKSKILL, NEW YORK, ASSIGNORS TO THE FLEISCHMANN COMPANY, OF NEW YORK, N. Y., A CORPORATION OF OHIO.

PROCESS FOR PRODUCING YEAST.

No Drawing. Application filed January 7, 1919. Serial No. 270,068.

To all whom it may concern:

Be it known that we, MARTIN NILSSON, a citizen of the United States, and NORMAN S. HARRISON, a subject of Great Britain, residing, respectively, in Peekskill, county of Westchester, and State of New York, have invented new and useful Improvements in Processes for Producing Yeast, of which the following is a full, clear, and exact specification.

Our invention relates to processes for the production of yeast and refers particularly to a process for the production of bakers' yeast from saccharíferous materials, such as molasses.

The object of our invention is the provision of a process for producing yeast with relatively high yields by growing it from seed yeast in a saccharíferous nutrient solution treated with yeast nutrient compounds, such solution being adapted for use in the art of yeast manufacture instead of cereal worts.

The usual procedure heretofore practiced in the production of yeast involved mashing malted cereals with water at certain temperatures in order to obtain a maximum amount of carbohydrates, proteins and mineral matters in solution. The resulting mash or wort was then filtered and the liquid stocked with yeast, after which it was aerated to promote the growth of yeast. The yeast thus produced was separated from the liquid by some suitable means. The process involving this procedure, however, is a comparatively expensive one as it requires a considerable amount of coal, labor and time incident to its proper practice, while the delicacy of the various operations requires careful and expert attention.

The process of our invention avoids these difficulties and presents a simplified procedure whereby a superior grade of yeast can be produced more economically, with greater certainty of results, and with increased yields.

In the practice of the process of this invention, yeast is propagated in a saccharíferous nutrient solution to which has been added compounds containing phosphorus, and nitrogen in yeast assimilable form, the propagation of yeast being allowed to proceed to the fullest desired extent, dependent upon the quality of yeast to be produced.

The compounds containing phosphorus intended to be included in the practice of this invention are those of an inorganic character adapted to yield at least a portion of their phosphorus content during the period of yeast propagation, as, for example, phosphorous acid; phosphoric acid; phosphate of ammonium; phosphates of alkali metals, such as sodium phosphate, or potassium phosphate; and phosphates of alkali earths, as calcium acid-phosphate, or magnesium acid-phosphate.

The compounds containing nitrogen are intended to include those which are adapted to supply inorganic nitrogen in yeast assimilable form; those preferably employed are ammoniacal compounds, as, for example, aqua-ammonia (ammonium hydroxide) and salts of ammonium.

Certain alkaline compounds, in this process, however, are the equivalent of aqua-ammonia when used with the addition of a suitable nitrogenous compound, as, for example, sodium hydrate, to which has been added ammonium phosphate. In the use of ammonium salts it is preferable always to add an alkali, as, for example, a carbonate or a hydrate, in order that free hydroxyl ions may be supplied while neutralizing the deleterious acidity developed during the period of yeast propagation. The second mentioned class of compounds would therefore include alkaline compounds when used in this manner.

The saccharíferous material employed in making the nutrient solution is of a character adapted to be subject to fermentation under the conditions of yeast propagation; among those which it is contemplated using are beet molasses and cane molasses.

Particularly valuable results are obtained by the use of beet molasses with the addition of a phosphate, such as ammonium phosphate, and ammonia; the yeast which is produced has great strength and improved lasting qualities, the cost of propagation being much less than that incident to the production of yeast by the processes heretofore generally employed.

Some yeasts, as is well known, are of such character that when exposed in masses for a short time tend to break down; when this is extreme they tend to pass into a slimy condition. By our process, however, a product is obtained which does not become slimy or deteriorate with age, and has therefore

what has been above referred to as lasting qualities, such qualities insuring that a mass of yeast will sustain its strong condition for a long period, the fermenting power also being retained.

In practicing the process of our invention, consideration of the results obtained appears to indicate that molasses is rich in practically all the materials necessary for yeast nourishment during the period of yeast propagation, with the exception of materials from which yeast assimilable nitrogen and phosphorus may be obtained while yeast is being propagated. Such constituents are of the greatest economical and commercial value in the manufacture of yeast since they allow the production of increased yields of a superior quality of yeast at a cost considerably below that grown from cereal worts. The saccharriferous material here employed is, however, deficient in these constituents, which deficiency is compensated for by the added compounds.

We have found that while yeast may be produced from cane molasses by our process, it is preferable to use beet molasses, as the yeast obtained from it is stronger, whiter, purer, more lasting, more easily manufactured and even less expensive that that produced from cane molasses.

By the process of this invention yeast can be propagated in a nutrient solution containing molasses, whether it be acid or alkaline, during the period of yeast growth, but we prefer that the condition of the nutrient solution be that of approximate neutrality since this condition appears to be conducive to maximum yeast production, though it is known that yeast multiplication is carried on most thoroughly when the nutrient solution is slightly acid. The acidity of the solution, however, if allowed to rise, will soon reach a point where the multiplication of yeast cells is deleteriously effected. On the other hand, if the solution is too strongly akaline there will be a cessation of yeast development, though not necessarily a cessation of the production of alcohol, it being known that the production of alcohol is dependent upon the presence of zymase and is therefore not directly commensurate with yeast multiplication.

The acidity which develops while yeast is multiplying is additive to the slight initial acidity preferably maintained for economic yeast culture, such acidity being produced by the partial assimilation of the salts in solution during the process of yeast propagation, which results in releasing acid radicals or components, as, for example, the partial assimilation of ammonium phosphate by yeast results in releasing the radical of phosphoric acid. It is for the purpose of rebinding the acid radicals thus released so as to restore the original conditions approximating neutrality as far as possible that compounds adapted to supply hydroxyl ions are added to the nutrient solution.

The following is an example of the process of our invention:—

560 pounds of practically neutral beet-molasses are diluted with 950 gallons of water and a solution of 14 pounds of phosphate of ammonium is gradually added. 11.2 pounds of yeast are then introduced. Air is blown into the mixture until the production of yeast is ended, the mixture being maintained in a practically neutral condition by the addition of ammonia from time to time to accomplish this result. The mixture is maintained at a temperature of 25°–30° C. during the operation which usually occupies about 24 hours. The yeast is then separated from the remainder of the mixture in any suitable manner. The process produces from 50%–60% of an extremely strong yeast which is not nearly as subject to deterioration as is the yeast produced in the ordinary way.

While the example given employs only one phosphorus-containing compound, a mixture of several phosphorus containing compounds may be used as a mixture of phosphate of ammonium and acid-phosphate of calcium.

We do not limit ourselves to the particular compounds, quantities, temperatures, duration of reaction or mode of procedure described, all of which may be varied without going beyond the scope of our invention as described and claimed.

Having described our invention, what we claim as new and desire to secure by Letters Patent is:

1. A process of producing yeast, which comprises preparing a yeast nutrient solution, propagating yeast therein with aeration, said yeast nutrient solution containing only molasses and inorganic compounds containing phosphorus and nitrogen, which are adapted to yield at least a portion of their content to the yeast and to set free components which tend increasingly to acidify the solution during propagation, and during the period of propagation neutralizing the excess of such acidity.

2. A process of producing yeast, which comprises preparing a yeast nutrient solution, propagating yeast therein with aeration, said yeast nutrient solution containing only molassses and phosphate of ammonium adapted to be at least partially assimilated by the yeast and to set free components which tend increasingly to acidify the solution during propagation, and during the period of propagation neutralizing the excess of such acidity.

3. A process of producing yeast, which

comprises preparing a yeast nutrient solution, propagating yeast therein with aeration, said yeast nutrient solution containing essentially molasses and inorganic compounds containing phosphorus and adapted to yield at least a portion of their content to the yeast and to set free components which tend increasingly to acidify the solution during propagation, and introducing into the solution during the period of propagation a compound, containing inorganic nitrogen in yeast assimilable form and having an alkaline reaction, in quantities adapted to neutralize the excess of such acidity.

4. A process of producing yeast, which comprises preparing a yeast nutrient solution, propagating yeast therein with aeration, said nutrient solution containing essentially molasses and phosphate of ammonium adapted to be at least partially assimilated by the yeast and to set free components which tend increasingly to acidify the nutrient solution during propagation, and introducing into the solution during the period of propagation a compound, containing inorganic nitrogen in yeast assimilable form and having an alkaline reaction, in quantities adapted to neutralize the excess of such acidity.

5. A process of producing yeast which comprises preparing a yeast nutrient solution, propagating yeast therein with aeration, said yeast nutrient solution containing essentially beet molasses and inorganic compounds containing phosphorus and adapted to yield at least a portion of their content to the yeast and to release components which tend increasingly to acidify the nutrient solution during propagation, and introducing into the nutrient solution an ammoniacal compound, adapted to supply inorganic nitrogen in yeast assimilable form and having an alkaline reaction, in amounts sufficient to neutralize the excess of such acidity.

6. A process of producing yeast which comprises preparing a yeast nutrient solution, propagating yeast therein with aeration, said yeast nutrient solution containing essentially beet molasses and phosphate of ammonium adapted to yield at least a portion of its content to the yeast and to release components which tend increasingly to acidify the nutrient solution during propagation, and introducing into the nutrient solution during the period of propagation aqua-ammonia in amounts sufficient to neutralize the excess of such acidity.

7. In the art of yeast manufacture, the process which comprises preparing in a fermentor a yeast nutrient solution containing essentially beet molasses and inorganic compounds adapted to supply phosphorus and nitrogen and to release components which tend increasingly to acidify the solution during propagation, seeding the solution with yeast, effecting propagation with aeration while maintaining the temperature between the limits of 25° to 30° C., and during the period of propagation neutralizing the excess of such acidity by the addition of an ammoniacal compound having an alkaline reaction.

8. In the art of manufacturing bakers' yeast, the process which comprises preparing a yeast nutrient solution in a fermentor with beet molasses and phosphate of ammonium adapted to supply at least a portion of its content and to release components which tend increasingly to acidify the solution during propagation, introducing seed yeast, effecting propagation with aeration at a temperature between the limits of 25° to 30° C., introducing into the fermentor aqua-ammonia in such quantities as to neutralize substantially the excess of said acidity, and thereafter separating the yeast.

9. A process of producing yeast, which comprises preparing a yeast nutrient solution, propagating yeast therein with aeration, said yeast nutrient solution containing only molasses and an inorganic compound containing phosphorus and nitrogen, which is adapted to yield at least a portion of its content to the yeast and to set free components which tend increasingly to acidify the solution during propagation, and during the period of propagation neutralizing the excess of such acidity.

10. A process of producing yeast, which comprises preparing a yeast nutrient solution, propagating yeast therein with aeration, said yeast nutrient solution containing essentially molasses and an inorganic compound containing phosphorus and adapted to yield at least a portion of its content to the yeast and to set free components which tend increasingly to acidify the solution during propagation, and introducing into the solution during the period of propagation a compound, containing inorganic nitrogen in yeast assimilable form and having an alkaline reaction, in quantities adapted to neutralize the excess of such acidity.

11. A process of producing yeast which comprises preparing a yeast nutrient solution, propagating yeast therein with aeration, said yeast nutrient solution containing essentially beet molasses and an inorganic compound containing phosphorus and adapted to yield at least a portion of its content to the yeast and to release components which tend increasingly to acidify the nutrient solution during propagation and introducing into the nutrient solution an ammoniacal compound, adapted to supply inorganic nitrogen in yeast assimilable form and having an alkaline reaction, in amounts sufficient to neutralize the excess of such acidity.

12. In the art of manufacturing bakers' yeast a step which comprises preparing a yeast nutrient solution, adapted for large commercial yields of yeast, consisting essentially of water, molasses and an inorganic compound containing phosphorus and nitrogen in yeast assimilable form, in amounts sufficient to supply all essential yeast nutrients during the propagating period.

13. In the art of manufacturing bakers' yeast the step which comprises preparing a yeast nutrient solution, adapted for large commercial yields of yeast, consisting of essentially water, molasses and an admixture of yeast nourishing inorganic compounds containing prosphorus and nitrogen in yeast assimilable form, in amounts sufficient to supply all essential yeast nutrients during the propagating period.

14. In the art of manufacturing bakers' yeast the step which comprises preparing a yeast nutrient solution, adapted for large commercial yields of yeast, consisting of essentially water, beet molasses and ammonium phosphate, in amounts sufficient to supply all esential yeast nutrients during the propagating period.

Signed at New York city, in the county of New York and State of New York, this 3rd day of January, 1919.

MARTIN NILSSON.
NORMAN S. HARRISON.

DEFENDANT'S EXHIBIT D-8-2.

Patented Mar. 20, 1923. 1,449,134

UNITED STATES PATENT OFFICE.

ALFRED WOHL, OF DANZIG-LANGFUHR, FREE CITY OF DANZIG, ASSIGNOR TO THE FLEISCHMANN COMPANY, OF NEW YORK, N. Y., A CORPORATION OF OHIO.

METHOD OF TREATING MOLASSES.

No Drawing. Application filed August 31, 1921. Serial No. 497,323.

To all whom it may concern:

Be it known that I, ALFRED WOHL, residing at Danzig-Langfuhr, Free City of Danzig, have invented certain new and useful Improvements in Methods of Treating Molasses (for which applications for patent were filed as follows: France, filed on June 11th, 1920; Denmark, filed on June 11th, 1920; United States of America, filed on June 23d, 1920; Czechoslovakia, filed on June 25th, 1920; Canada, filed on July 10th, 1920; Spain, filed on July 14th, 1920; Rumania, filed August 6th, 1920; Germany, filed April 6th, 1920), of which the following is a specification.

This invention relates to a method of treating molasses with a view to its later utilization in the fermentation industries and more particularly relates to a method of clarifying molasses while in a fairly concentrated state and by heating only to a relatively low temperature, with a view to the propagation of yeast of good keeping qualities, color and baking strength, therein.

An object of this invention is to accomplish such clarification and sterilization of molasses by an efficient method which is commercially practicable and easily carried out with a minimum of time, labor and cost.

Another object is to obviate the long, expensive, and tedious boiling commonly practiced.

Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly consists in the several steps and the relation and order of one or more of such steps with respect to each of the others thereof, which will be exemplified in the hereinafter disclosed method and the scope of the application of which will be indicated in the claims that follow.

The methods heretofore employed for producing compressed yeast from molasses are based upon the assumption previously existing that a boiling of an acidulated solution of molasses is necessary, both for the purpose of inverting the sugar and separating the constituents difficult of solution, and for sterilizing the molasses. Although the first effect, that of inverting the sugar, is accomplished by boiling acidulated molasses, it is known that sugars are inverted by certain enzymes in yeast. However, for the purpose of sterilization, boiling has been considered to be essential.

I have found that compressed yeast of good keeping qualities and answering all requirements of a good bakers' yeast can be produced from molasses and ammonium salts without further organic nitrogenous foods, without lactic acid fermentation or the addition of lactic acid, and also without boiling, if the molasses, in a moderately concentrated solution, for instance, 30 to 40° Brix, is mixed with large quantities of strong mineral acid and allowed to stand at ordinary temperature or at a gentle heat until sterilization is accomplished. This should be done before any further dilution in order not to use unnecessarily large quantities of acid, which would be required to bring the degree of acidity up to the desired amount, and which would later necessitate the neutralization of a large portion of the acid.

As an example, the quantity of mineral acid necessary, is that which will be sufficient to acidify the subsequent solution of molasses up to the strength needed for producing yeast of good quality without souring by the addition or formation of lactic acid. For instance, I find that to every 100 parts by weight of molasses, about 2 parts by volume of concentrated sulphuric acid, which has been preferably previously diluted with a little water, should be used. The difference as compared with the method of acidulation heretofore practiced lies in the fact that these quantities of acid are, in the form of a strong mineral acid, e. g. sulphuric acid or hydrochloric acid, added to the molasses in a relatively high concentration and after they have exercised their sterilizing effect a suitable dilution is effected.

My method of causing the quantities of acid which will afterwards be required for acidifying the highly diluted fermentative or yeast wort, to act prior to the final dilution of the molasses also allows a further step which improves the hitherto exceedingly inefficient utilization of the mineral phosphoric acid and phosphates as yeast foods.

If phosphoric acid is added, as is usually the case, as super-phosphate, a considerable proportion of the phosphoric acid always

remains unused. I overcome this inefficiency by first strongly heating together the super-phosphate and the mineral acid intended for the acidulation of molasses, then adding the mixture to the molasses and heating in the manner hereinbefore described, whereby the molasses is not only sterilized but phosphoric acid is obtained in a form which is readily assimilable by yeast.

When super-phosphate and sulphuric acid are treated as above described, gypsum (calcium sulphate) is formed by their reaction and this is later disseminated throughout the acidified solution of molasses. Since calcium sulphate readily combines with sulphate of potassium to form calcium-potassium sulphate, the calcium sulphate combines with the potassium salts present in the molasses to form insoluble calcium-potassium sulphate which accordingly separates from the molasses and accomplishes in a simple and efficient manner, the reduction of the amount of potassium salts in the molasses. This decrease or reduction in the amount of potassium salts present in the molasses may be increased by the addition of more gypsum to the concentrated and acidulated molasses.

Moreover when super-phosphate is treated with sulphuric acid as above described, some calcium sulphate is precipitated out, and this precipitate may be separated from the liquid if desired, but preferably the liquid and precipitate are both added to the molasses whereby the clarifying effect of the precipitate is utilized. In the former case, special measures are necessary for the practical clarification of the molasses solution. This may be done by allowing the bulk of the deposit to settle and filtering the pre-clarified solution through a flat filter or a sand filter. From the constituents rich in slime, there are then obtained, by means of a centrifugal separator, further quantities of liquid, poor in slime and hence easily filtered, which liquid is then clarified in the above manner. The mud residue can be drawn off with acidulated water and centrifuged or can be used for the manufacture of spirit without the production of yeast.

In order to test the sufficiency the above method, separate portions of molasses were inoculated with traces of two mildew fungi (Mucor and Aspergillus) and two bacteria (*Bacterium lactis* and *butyricum*), and allowed to stand for 8 days at 25° C. From these portions a solution of 30° Brix was made at ordinary temperature, with the addition of acid as indicated; a second solution without an addition of acid was also taken. These solutions were tested after 24 hours, as to the number of micro-organisms present therein, by inoculation upon nutrient gelatine. The first solution was found to be entirely sterile whereas the second solution contained on the average of 1800 organisms per cubic centimeter.

As many changes could be made in carrying out the above method without departing from the scope of the invention, it is intended that all matter contained in the above description shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention, which, as a matter of language, may be said to fall therebetween.

This application is a continuation of certain subject-matter originally disclosed in my co-pending application, Serial No 391,156, filed June 23, 1920.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. The method of treating molasses which comprises adding thereto a mineral acid and a phosphate.

2. The method of treating molasses which comprises, adding thereto a mineral acid and a phosphate, and heating the mixture moderately.

3. The method treating molasses which comprises, adding thereto a mixture of a mineral acid and a phosphate, heating the final mixture until a precipitate is formed, and separating the precipitate from the liquid.

4. The method of preliminary treatment of molasses for use in the fermentation industries which comprises, treating a phosphate with an excess of mineral acid, heating the same, adding the resultant mixture to the molasses, and heating the final mixture until a precipitate is formed.

5. The method of preliminary treatment of molasses for use in the fermentation industries which comprises, treating a phosphate with an excess of mineral acid, heating the same, adding the resultant mixture to the molasses, heating the final mixture until a precipitate is formed, and separating the precipitate from the liquid.

6. The method of preliminary treatment of molasses for use in the fermentation industries which comprises, treating a phosphate with an excess of a mineral acid, and adding the resultant mixture to the molasses.

7. The method of preliminary treatment of molasses for use in the fermentation industries which comprises, treating a phosphate with an excess of a mineral acid, heating the same, and adding the resultant mixture to the molasses.

8. The method of preliminary treatment

of molasses for use in the fermentation industries which comprises, heating an excess of mineral acid with a phosphate until a precipitate is formed, adding the mixture to the molasses, and heating moderately.

9. The method of preliminary treatment of molasses for use in the fermentation industries which comprises, heating an excess of mineral acid with a phosphate until a precipitate is formed, separating the precipitate from the liquid, adding the liquid to the molasses, and heating the final mixture moderately.

10. The method of preliminary treatment of molasses for use in the fermentation industries which comprises, heating an excess of mineral acid with a super-phosphate until a precipitate is formed, and adding the mixture to the molasses.

11. The method or preliminary treatment of molasses for use in the fermentation industries which comprises, heating an excess of mineral acid with a super-phosphate until a precipitate is formed, adding the mixture to the molasses, and heating moderately.

12. The method of preliminary treatment of molasses for use in the fermentation industries which comprises, heating an excess of mineral acid with a super-phosphate until a precipitate is formed, separating the precipitate from the liquid, and adding the liquid to the molasses.

13. The method of preliminary treatment of molasses for use in the fermentation industries which comprises, heating an excess of mineral acid with a super-phosphate until a precipitate is formed, separating the precipitate from the liquid, adding the liquid to the molasses, and heating the final mixture moderately.

14. In the art of yeast manufacture, the steps in the preparation of a yeast nutrient solution which comprise, preparing a moderately concentrated solution of molasses, treating a super-phosphate with a mineral acid, heating the latter mixture until a precipitate is formed, adding the resultant mixture to the molasses solution, moderately heating the final mixture until a precipitate is formed, and separating the precipitate from the liquid.

15. In the art of yeast manufacture, the steps in the preparation of a yeast nutrient solution which comprise, preparing a moderately concentrated solution of molasses, adding thereto a mixture of a mineral acid and a phosphate, and treating the resultant mixture in such a manner that a portion of the mineral salts, originally present in the molasses, combine with the materials added to the molasses to form an insoluble salt which may be readily separated from the molasses.

16. In the art of yeast manufacture, the steps in the preparation of a yeast nutrient solution which comprise, preparing a moderately concentrated solution of molasses, adding thereto a mixture of a mineral acid and a phosphate, heating the resultant mixture, whereby a portion of the mineral salts originally present in the molasses, combine with the mixture added to the molasses to form an insoluble salt, and to set phosphoric acid free in a form which is readily assimilable by yeast, and separating the precipitate from liquid.

17. In the art of yeast manufacture, the steps in the preparation of a yeast nutrient solution which comprise, preparing a moderately concentrated solution of molasses and adding thereto such an excess of mineral acid, as will upon final dilution, produce in the resultant yeast nutrient solution an acidity which approximates the optimum for the yeast propagation.

18. In the art of yeast manufacture, the steps in the preparation of a yeast nutrient solution which comprise, preparing a moderately concentrated solution of molasses and adding thereto a phosphate and such an excess of mineral acid, as will upon final dilution produce in the resultant yeast nutrient solution an acidity which approximates the optimum for the yeast propagation.

19. The method of preliminary treatment of molasses for use in the fermentation industries which comprises, acidifying the molasses, adding gypsum thereto, and after a precipitate is formed, separating the precipitate from the liquid.

20. The method of preliminary treatment of molasses for use in the fermentation industries which comprises, acidifying the molasses, adding gypsum thereto, and moderately heating the resultant mixture until a precipitate is formed.

In testimony whereof I affix my signature in presence of two witnesses.

ALFRED WOHL.

Witnesses:
HOWARD A. BOURMAN,
WILLIAM M. ROBERTSON.

DEFENDANT'S EXHIBIT D-8-3.

Patented Nov. 27, 1923. 1,475,215

UNITED STATES PATENT OFFICE.

ALFRED WOHL, OF DANZIG-LANGFUHR, FREE CITY OF DANZIG, ASSIGNOR TO THE FLEISCHMANN COMPANY, OF NEW YORK, N. Y., A CORPORATION OF OHIO.

PROCESS FOR THE MANUFACTURE OF YEAST.

Continuation of applications filed June 23, 1920, Serial No. 391,156, and August 31, 1921, Serial No. 497,223. This application filed August 31, 1921. Serial No. 497,221.

(GRANTED UNDER THE PROVISIONS OF THE ACT OF MARCH 3, 1921, 41 STAT. L., 1313.)

To all whom it may concern:

Be it known that I, ALFRED WOHL, residing at Danzig-Langfuhr, Free City of Danzig, have invented certain new and useful Improvements in the Process for the Manufacture of Yeast (for which application for patent were filed as follows: France, filed June 11, 1920; Denmark, filed June 11, 1920; United States of America, filed June 23, 1920; Czechoslovakia, filed June 25, 1920; Canada, filed June 10, 1920; Spain, filed July 14, 1920; Rumania, filed August 6, 1920; Germany, filed January 15, 1915, Patent 310580; Sweden, filed December 29, 1919; Poland, filed June 7, 1920), of which the following is a specification.

This invention relates to the production of yeast and more particularly to the production of yeast in a nutrient wort which is made from cereal material in the usual proportions except that the amount of organic nitrogen usually used is materially reduced, and the missing yeast-assimilable nitrogen is replaced by an inorganic compound containing yeast-assimilable nitrogen.

An object of this invention is the production of compressed yeast by a process which is adapted to be easily carried out, producing a large yield of yeast and materially lowering the cost of production of the yeast as compared with that produced in the usual cereal wort process.

Another object of the invention is the production of yeast from a nutrient solution containing essentially sacchariferous material and other yeast nutrients including cereal material and inorganic nitrogen containing compounds adapted to be at least partially assimilated by the yeast and during such assimilation to set free components which tend increasingly to acidify the nutrient solution, the yeast-assimilable organic nitrogen contained in the cereal material being present to an appreciably lesser degree than in a usual cereal wort, and the missing yeast assimilable nitrogen being added in the form of inorganic compounds. The propagation is carried on with aeration, and at least a substantial portion of the released acidity is neutralized at the election of the operator, the yeast obtained from this wort, either with or without neutralization, being capable of yielding sturdy successive generations indefinitely in continuous operation, that is, without revivification.

Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly consists in the several steps and the relation and order of one or more such steps with relation to each of the others thereof, which will be exemplified in the hereinafter disclosed process and the scope of the application of which will be indicated in the claims that follow.

The nitrogenous substances which are used for nutrition in the growth of yeast can emanate from very different sources. Generally, amino nitrogen is considered the most favorable for fermentation and for the increase of the yeast. In the practical manufacture of aerated yeast, malt sprouts are generally used in addition to malt as a source of nitrogenous food. The indefinitely continued commercial production of yeast of fully satisfactory quality in successive generations without revivifications, with inorganic salts of ammonia as the sole nitrogen source is not possible. Experiments show that the yield and fermentative power fall with exceeding rapidity to values which are of no use in practice as soon as the excess of organically bound nitrogen contained in the seed yeast is expended.

The process hereinafter described is based on the new and unexpected observation that a partial substitution of yeast-assimilable organic nitrogen by the cheaper inorganic ammonium salts, up to the extent indeed of nearly one-half, has practically no influence on the yield of yeast and the fermentative power of the yeast produced. Beyond this limit a noticeable reduction, which grows larger in proportion as the organic nitrogen decreases, takes place in the yield of yeast, as is shown by the accompanying curve representing the results of experiments, this being especially true unless at least a substantial portion of the acidity, which results from a partial assimilation of the inorganic ammonium salts and the consequent release of components from such

salts which tend to produce an increasing acidity, be neutralized.

We are here dealing with an effect in which the organic nitrogen compounds and the ammonium salts mutually contribute to the nutrition of the yeast. For example, if in an experiment the ammonium salts are omitted, then under otherwise similar conditions instead of 4.6, only 2.99 grams of dry substance will be obtained, in the shape of newly formed yeast, per 1 litre of 2½% sugar solution.

In the experiments shown in the curve a total concentration of nitrogen was used sufficient for a maximum yield by weight, but not sufficient to keep the newly produced yeast up to the nitrogen content of the seed yeast, for in that case the total quantity would as in actual practice, have to be increased about 2½ to 3 times. Then again it is found however that a mixture in the proportion of 40 to 50% of the total yeast-assimilable nitrogen in the form of ammonium salts is entirely sufficient to allow of breeding six or more generations of yeast in succession without the yield or proportion of nitrogen falling off more rapidly than would be the case in actual practice where the same content of nitrogen is offered by malt sprouts and malt. Indeed according to the present invention the germinating power is even better preserved than under known working conditions.

With a view to improving the properties of the yeast, it is found useful to supply the ammonium salts in two or more stages. This does not influence the yield, but imparts a better compressibility to the yeast.

From the summary of the literature by Pringsheim published in the Wochenschrift f. Brauerei 1907, page 126, it is known that, qualitatively, yeast can take up nitrogen as a food in the form of ammonia both from solutions containing ammoniacal nitrogen (Bokorny) and from solutions containing ammoniacal nitrogen mixed with asparagin (Petit.) but it is also known that with ammoniacal nitrogen alone, it can not be so fed that it remains practically useable. This is also confirmed by our experiments. The summary of literature also sets forth that ammoniacal nitrogen is taken up by yeast in the same manner as is asparagin nitrogen (Petit.) the former, at the optimum temperature, even to a large extent (Laborde.) but that the yield of yeast in these nutrients drops from peptone to asparagin (Kussorow) and to ammonium sulphate (Bokorny). This latter observation is also confirmed by our experiments and precludes a direct practical utilization of all these data for the feeding of yeast.

French Patent No. 343,133, which relates to improvements in the course of fermentation, not to the production of yeast, is based upon the use of extract of yeast as nitrogenous food. Apart from this it recommends an addition of inorganic mineral salts (SO_3, P_2O_5, CaO, MgO). Among other phosphates such as potassium phosphate there is mentioned phosphate of ammonia. This equivalency to potassium phosphate as well as the indefinite amounts prescribed, prove that the ammonium salt is here only mentioned as a well-known kind of phosphoric acid food. The same applies to British patent specification No. 21,011/1896 and to the publication concerning the same matter in the Wochenschrift f. Brauerei 1898, p. 237, from which it can be seen that as an origin of nitrogen, maltopeptone is used, and in this only 6% of the nitrogen is present as ammoniacal nitrogen.

It has also been shown that ammonia salts increase the nitrogenous contents and the germinating power of yeast. (see Zeitschrift für Spiritus-Industrie 1910, supplement to No. 11, page 3, col. 1, observations 4 and 5,) but the adding of ammonia salts hitherto has been done in comparatively small quantities only, and it was not realized that it would be possible to work with an exceedingly low concentration of organic nitrogenous substances as compared to the concentration of carbohydrates.

The statement in the Jahrbuch des Vereins der Spiritus-Fabrikanten in Deutschland, second year, (1911 p. 23, paragraph 1) that ammonium salts are utilized by yeast in large quantities for building up its body substance, contains nothing about the conditions under which this is possible in order to have the most favorable yield with reference to the total nitrogen used. From a closer description of experiments in this relation, it is found that in the reaction filter the assimilation of nitrogen by yeast from a sugar solution containing ammonium sulphate, drops from roughly 30% to roughly 7% (Jahrbuch des Vereins der Spiritus-Fabrikanten in Deutschland, 1912, page 37, paragraph 2). Further results of these works are also recorded in the same Jahrbuch, 1913, at the bottom of page 33 and the top of page 34 where the following summary of results achieved are summarized as follows:

1. That ammonium salts cannot even remotely be regarded as complete nitrogen food for yeast.

2. That on the contrary a mixture of amino acids such as is obtained, for instance, from autodigestion of yeast, ensures full nutrition and probably a better nutrition than the albumen, albumose, and peptone feeding such as is presented by use of malt liquor (wort.)

Neither the more favorable utilization of the nitrogen, which is obtained in a suitably proportioned mixture of organic nitro-

gen and ammonia nitrogen, the longer inheritance of the good properties of the yeast produced under these conditions, nor yet the good keeping quality and the influence on pressing qualities of yeast which is produced by the gradual addition of ammonium salts, have hitherto been recognized. All these points, however, are of importance in the practical application of the hereinafter described process of the manufacture of yeast, with aeration, capable of yielding sturdy successive generations indefinitely without revivification and are in striking contrast to experiments which have been carried out in the past and the object of which was only to enrich the wash with albuminous substances and in which no consideration was taken of the properties of yeast which are highly desirable in the commercial compressed yeast manufacturing industry.

Moreover it might be presumed that, with the ordinary organic nitrogenous food, if a comparatively small quantity of ammoniacal nitrogen were supplied in addition, the properties of the yeast would not be altered to any appreciable extent and perhaps also that a quantitatively inconsiderable substitution would not have any effect on the yield of yeast. On the other hand the perception of the fact which is of importance from the point of view of the practical invention, that a substitution of organic nitrogen by ammoniacal nitrogen is possible to so large an extent that a practical advantage results without impairment of the properties of the yeast, its fermenting powers, further propagating powers, or its yield, and that such substitution, has a favorable influence of these properties, is a new discovery.

Although in Example I, which appears hereinafter, an example of that what I have termed a "usual cereal wort" is set forth, it is to be understood that, since the various components of different cereal materials vary within quite wide limits, the formula given is merely an example and may be correspondingly varied in the manner well known to yeast manufacturers. It is pointed out, however, that although the green malt contains a certain percentage of yeast-assimilable organic nitrogen, the malt sprouts contain by far the larger part of the yeast-assimilable organic nitrogen and that, therefore, if in any cereal wort containing approximately the usual amount of yeast-assimilable organic nitrogen supplying materials, a considerable portion thereof be omitted and ammonium salts be added to replace the yeast-assimilable organic nitrogen thus omitted, such replacement of yeast-assimilable organic nitrogen by yeast-assimilable inorganic nitrogen would fall within my disclosure provided that the replacement was more than ten per cent, and did not greatly exceed fifty per cent. The remaining examples, II to V inclusive, show typical compositions of various worts in which varying percentages of yeast-assimilable organic nitrogen have been replaced by yeast-assimilable inorganic nitrogen.

Furthermore, although in Example I the use of no neutralizing agent has been suggested, for the reason that I have found it possible to attain desirable results without the use of such neutralizing agent, however, if as is shown in Example II, not only is a material portion of the organic nitrogen contained in the malt sprouts omitted, but also a considerable portion of the cereals containing saccharifiable matter is omitted, at least a part of the sugars so omitted being replaced by the addition of sugar, I have found it desirable to neutralize at least a substantial portion of the acidity formed in the solution as a result of the partial assimilation of the ammonium salts by the yeast, by incorporating with the wort a relatively insoluble innocuous antacid carbonate or a mixture of such carbonates, such as calcium or magnesium carbonates, adapted progressively to neutralize the released acidity. Although no such addition of a neutralizing agent has been shown in Example I, yet, as has been pointed out above, even though it is not necessary, such may be added at the election of the operator and is therefore comprehended within my invention.

The systematic experiments which had led to these discoveries have been based upon the principle of ascertaining whether a practically useful yeast, in a yield which is commercially practicable could be obtained with a mixed food when it is known that such a yeast and such yields could not be obtained by a process wherein the nitrogenous food is supplied only in the form of ammoniacal salts. That this could be done to practical advantage was the unforeseen result applying to the special case of the production of yeast by the aeration process.

As illustrative of the method of carrying out my invention the following examples are given:

I. In a usual mash composed of 40% malt sprouts, 20% green malt and 40% maize comprising a total mash of 100 hundredweights only 10 hundred-weights of malt sprouts are used and the nitrogen which is usually supplied by the other 30% of malt sprouts is supplied in the form of ammoniacal salts, for example, 150 kilograms of ammonium sulphate or a corresponding amount of ammonium phosphate $(NH_4)_2HPO_4$, ammonium nitrate or other ammonium salt or mixture of salts. The cereals are mashed in the usual manner and the resulting wort is seeded with eight per cent of seed yeast and aerated for about 10

hours, the ammonium salts being gradually added during the propagating period. After the propagation is completed, the yeast is separated and packed in suitable manner

II. A mash of 90 kilograms of cane sugar and 45 kilograms of germinated malt is mashed and the resultant wort is seeded with 15 to 20 kilograms of seed yeast, there being gradually added 9 kilograms of ammonium sulphate, 1½ kilograms of superphosphate and 2½ kilograms each of calcium carbonate and magnesium carbonate. The yield after deducting the seed yeast is 65 kilograms yeast with 54% albumen in the dry substance and 30 litres of spirit. This is 48.1% a yeast and 22.2% spirit, totalling 70.3% relatively to the cane sugar; or 34.4% yeast and 18.2% spirit, totalling 57.6% as referred to the grain used.

III. A mash of 90 kilograms of cane sugar, 25 kilograms of germinated malt, 2½ kilograms of ammonium sulphate, 0.2 kilograms of magnesium sulphate and 2½ kilograms of calcium carbonate is treated as above and from the same, after deducting the seed yeast, there is obtained 39 kilograms of yeast and 40 litres of spirit. This makes 33.9% yeast and 34.8% spirit, totalling 68.7% relatively to the cane sugar; or 26.8% yeast and 27.6% spirit, totalling 54.4% referred to the grain used.

IV. A mash of 900 kilograms of green malt, 500 kilograms of germinated malt and 3200 kilograms of cane sugar (combined mash of a weight of 5140 kilograms) is started with 400 kilograms of yeast, with a gradual addition of 60 kilograms of ammonium sulphate and 60 kilograms of calcium carbonate, and are aerated in the usual way. There is obtained net 1740 kilograms of good and well pressable yeast and 1620 litres of spirit. This makes 40.5% of yeast and 37.6% of spirit, totalling 78.1% relatively to cane sugar; 33.8% yeast and 31.5% spirit, totalling 65.3% relatively to the grain used. According to Examples (III) and (IV), one and the same yeast was carried forward for months in a distillery.

V. In a further working experiment according to Example IV, but without the addition of ammonium sulphate and with addition of 400 kilograms of dry spent grain, there was obtained a net yield of 1410 kilograms yeast and 1620 litres of spirit. This makes 32.7% yeast and 37.6% spirit, totalling 70.3% relatively to cane sugar: or 27.4% yeast and 31.5% spirit, totalling 58.9% relatively to the grain used. The spent grain added for filtering has not been taken into account at all in calculating the yield relative to the grain used otherwise the difference would be a little greater still.

Example IV cannot be directly compared with Examples II and III because in the Example IV green malt also is used and this supplies nitrogen in a form which is readily assimilated by yeast.

As certain changes could be made in carrying out the above process without departing from the scope of the invention, it is intended that all matter contained in the above description shall be interpreted as illustrative and not in a limiting sense.

This case is a continuation of my co-pending application, Serial No. 391,156 filed June 23, 1920, and a continuation of and a consolidation with my co-pending application, Serial No. 497,322 filed August 31, 1921.

Having described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. The process of manufacturing yeast which comprises preparing a cereal wort in which the yeast-assimilable organic nitrogen is replaced to an amount of from 10% to 50% by yeast-assimilable ammoniacal nitrogen, and propagating yeast therein with aeration.

2. The process of manufacturing yeast which comprises preparing a cereal wort including an amount of yeast-assimilable organic nitrogen which is less, by from 10% to 50%, than the amount normally present in a usual cereal wort, supplying the deficiency of yeast-assimilable organic nitrogen by adding inorganic salts containing yeast-assimilable nitrogen, and propagating yeast therein with aeration.

3. The process of manufacturing yeast which comprises preparing a cereal wort including an amount of yeast-assimilable organic nitrogen which is less, by from 10% to 50%, than the amount normally present in a usual cereal wort, propagating yeast therein with aeration, and during the process of propagation supplying the deficiency of yeast-assimilable nitrogen by the fractional addition of an inorganic compound containing yeast-assimilable nitrogen.

4. The process of manufacturing yeast which comprises preparing a yeast nutrient solution, containing essentially sacchariferous material and other yeast nutrients, including cereal material and an inorganic compound containing yeast-assimilable nitrogen substituted for organic nitrogen normally present in a usual cereal wort to an extent whereby the yeast is capable of yielding sturdy successive generations indefinitely in continued operation, and propagating yeast therein with aeration.

5. The process of manufacturing yeast capable of yielding sturdy successive generations indefinitely in continued operation, which comprises preparing a yeast nutrient solution, containing essentially sacchariferous material and other yeast nutrients including cereal material present only in such

amounts as will cause the yeast nutrient solution to contain from 10% to 50% less than the amounts of yeast-assimilable organic nitrogen normally present in a usual cereal wort and including an inorganic compound containing yeast-assimilable nitrogen in amounts sufficient to supply the deficiency of yeast-assimilable nitrogen, and propagating yeast therein with aeration.

6. The process of manufacturing yeast capable of yielding sturdy successive generations indefinitely in continued operation, which comprises preparing a yeast nutrient solution containing essentially saccharifer-ous material and other yeast nutrients, including cereal material present only in such amounts as will cause the yeast nutrient solution to contain from 10% to 50% less than the amounts of yeast-assimilable organic nitrogen normally present in a usual cereal wort, propagating yeast therein with aeration, and during the process of propagation supplying the deficiency of yeast-assimilable nitrogen by the fractional addition of inorganic compounds containing yeast-assimilable nitrogen.

7. The process of manufacturing yeast which comprises preparing a cereal wort in which the yeast-assimilable organic nitrogen is replaced to an amount from 10% to 50% by yeast-assimilable ammoniacal nitrogen containing compounds from which components are liberated which tend increasingly to acidify the wort during propagation, adding to the wort sufficient amounts of a relatively insoluble innocuous antacid carbonate to neutralize at least a substantial portion of such acidity, and propagating yeast therein with aeration.

8. The process of manufacturing yeast which comprises preparing a cereal wort including an amount of yeast-assimilable organic nitrogen which is less by from 10% to 50% than the amount normally present in a usual cereal wort, supplying the deficiency of yeast-assimilable nitrogen by adding inorganic salts containing yeast-assimilable nitrogen and from which components are liberated which tend increasingly to acidify the wort during propagation, adding to the wort sufficient amounts of a relatively insoluble innocuous antacid carbonate to neutralize at least a substantial portion of such acidity, and propagating yeast therein with aeration.

9. The process of manufacturing yeast capable of yielding sturdy successive generations indefinitely in continued operation, which comprises preparing a yeast nutrient solution containing essentially saccharifer-ous material and other yeast nutrients, including cereal material present only in such amounts as will cause the yeast nutrient solution to contain from 10% to 50% less than the amounts of yeast-assimilable organic nitrogen normally present in a usual cereal wort and including an inorganic compound containing yeast-assimilable nitrogen in amounts sufficient to supply the deficiency of yeast-assimilable nitrogen and from which components are liberated which tend increasingly to acidify the wort during propagation, adding to the wort sufficient amounts of a relatively insoluble innocuous antacid carbonate to neutralize at least a substantial portion of such acidity, and propagating yeast therein with aeration.

10. The process of manufacturing yeast capable of yielding sturdy successive generations indefinitely in continued operation which comprises preparing a yeast nutrient solution containing essentially saccharifer-ous material and other yeast nutrients, including cereal material present only in such amounts as will cause the yeast nutrient solution to contain from 10% to 50% less than the amounts of yeast-assimilable organic nitrogen normally present in a usual cereal wort, adding to the wort a relatively insoluble innocuous antacid carbonate, propagating therein yeast with aeration, and during the process of propagation supplying the deficiency of yeast-assimilable nitrogen by the fractional addition of an inorganic compound containing yeast-assimilable nitrogen, said insoluble innocuous antacid carbonate being present in amounts sufficient to neutralize at least a substantial portion of such acidity.

In testimony whereof I affix my signature in presence of two witnesses.

ALFRED WOHL.

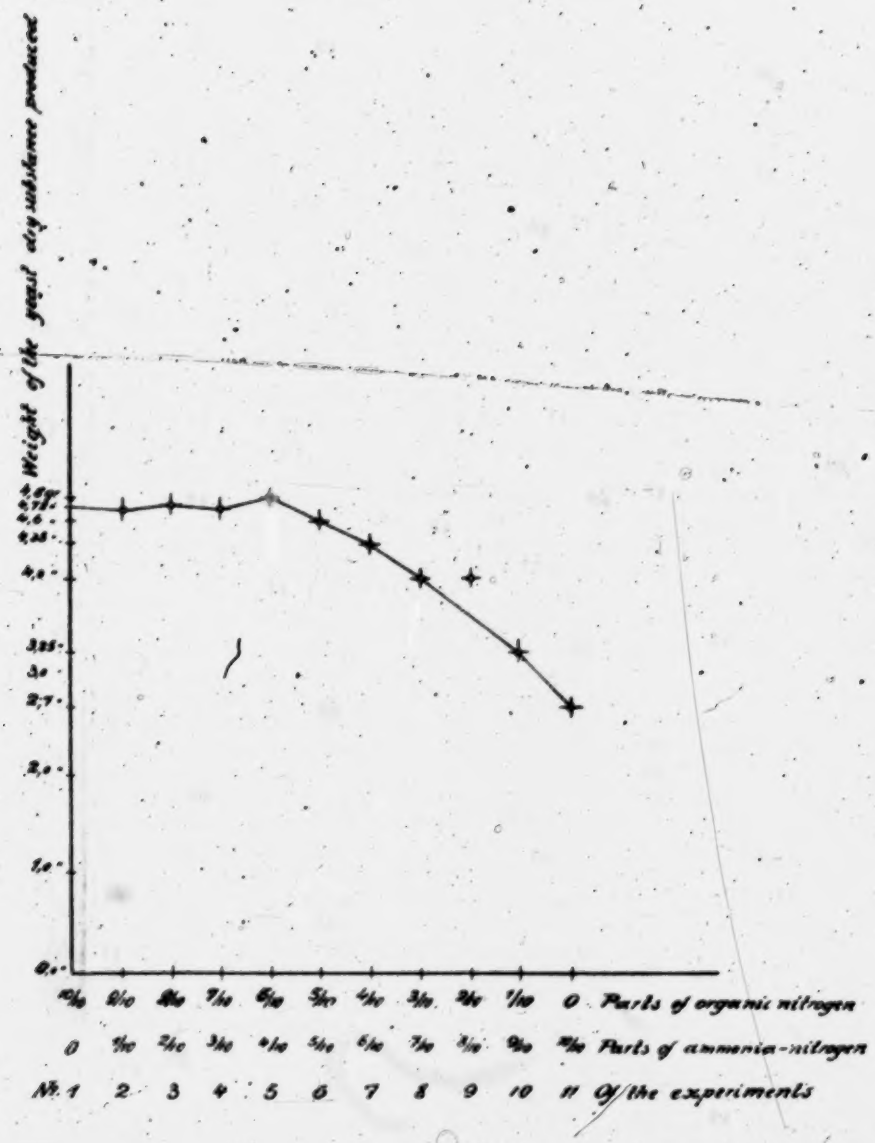
Witnesses:
HOWARD A. BOWMAN,
WILLIAM M. ROBERTSON.

Nov. 27, 1923. 1,475,215

A. WOHL

PROCESS FOR THE MANUFACTURE OF YEAST

Filed Aug. 31, 1921



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DEFENDANT'S EXHIBIT D-8-4.

Patented Oct. 23, 1928. 1,688,831

UNITED STATES PATENT OFFICE.

FRED RANSCHOFF, OF NEW YORK, N. Y., ASSIGNOR TO THE FLEISCHMANN COMPANY, OF NEW YORK, N. Y., A CORPORATION OF OHIO.

METHOD OF TREATING MOLASSES.

No Drawing. Application filed May 11, 1925. Serial No. 29,623.

This invention relates to the treatment of impure sacchariferous solutions for use in the fermentation industries and more particularly to the clarification of molasses for use in the manufacture of yeast and has as its general object the carrying out of such treatment in a more efficient and economical manner than heretofore.

A more particular object of the present invention is the treatment of cane molasses as the latter is usually commercially obtained in bulk, or a mixture thereof with other sacchariferous substances for the purpose of removing from the molasses certain substances ordinarily present therein which tend seriously to interfere with its use in processes of manufacturing bakers' yeast and to cause the yeast produced therefrom to be of inferior quality.

A further object of the invention is so to carry out the above treatment or clarification that the sacchariferous material is simultaneously enriched with yeast-assimilable substances of such nature and in such quantities as materially to augment its value in yeast production.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the several steps and the relation and order of one or more of such steps with respect to each of the others thereof, which will be exemplified in the method hereinafter disclosed, and the scope of the application of which will be indicated in the claims.

Although sacchariferous yeast-nutrient solutions have in recent years been employed successfully in commercial production of bakers' yeast, utilizing both beet and cane molasses as the principal or exclusive source of sugars, available for the yeast growth, more or less difficulty has been experienced in obtaining uniform results as to quality and yield of yeast, especially when cane molasses is used as a source of sugar material.

Cane molasses as it is ordinarily obtained on the market is unsuitable for fully satisfactory use in most present day processes of yeast production for the reason that it usually contains comparatively large amounts of the heavier metals such as iron, aluminum, magnesium and calcium, and is also contaminated with considerable quantities of dirt, sand and various colloidal and pectine substances of unknown composition. Some of these substances are detrimental from the standpoint of the yeast manufacturer for the reason that if they are allowed to remain in the solution they tend deleteriously to affect the baking and keeping qualities of the yeast, causing rapid discoloration thereof and rendering it generally objectionable for bakers' use, while some are of such a nature as to render the molasses very difficult of filtration. Moreover, cane molasses is largely deficient in substances which are considered to be highly desirable in the commercial manufacture of yeast as for example, yeast-assimilable nitrogen, potassium, and phosphorus.

By the use of the present invention not only are the substances detrimental to the yeast-nutrient solution and which have heretofore been found to be quite difficult of removal, effectively removed from the solution, but the solution is simultaneously enriched to a considerable degree in the above mentioned substances which are so desirable from the standpoint of yeast manufacture.

According to the present invention, the clarification of the molasses is accomplished by diluting the same and rendering it distinctly alkaline by the addition thereto of suitable alkali materials or a mixture of such materials, containing one or more components which are readily assimilable by yeast, and in which the raw material is deficient, such as, for example, the hydroxides or carbonates of ammonium or potassium or mixtures thereof, and adding thereto a suitable substance capable of forming therein a phosphate precipitate hereinafter referred to as a "phosphate precipitant", as for example, phosphoric acid or the phosphates of ammonium or potassium, whereupon the molasses is heated moderately to complete the formation of the precipitate and is filtered in any suitable manner with or without the aid of the well known aids to filtration, such as for example, kieselguhr, filtercel and the like.

The following is a specific example of the method of carrying out the process:

The molasses is slightly diluted with water to the amount of about 2 parts of water to 1 part of molasses by volume, although a greater dilution may be used if desired. To the diluted molasses sufficient aquaammonia is added to render the same distinctly alka-

line, as for example, to a degree such that 2.0 cc. normal sulphuric acid solution will be required to neutralize 100 cc. of the alkaline molasses. The quantity of alkali substances required for this purpose may vary somewhat for different batches of cane molasses in view of the fact that the latter as usually obtained on the market possesses varying degrees of acidity.

After the diluted molasses has been rendered alkaline as described, there is added to it a suitable quantity of mono-ammonium-dihydrogen phosphate ($NH_4H_2PO_4$) as for example, about 1% of the original weight of the molasses under treatment before dilution. The phosphate is preferably added to the diluted molasses in the form of an aqueous solution of any convenient strength, and after its addition the mass is mixed thoroughly and heated moderately to a temperature sufficient to complete the precipitation and clarification, as for example, to from between 80° C., and the boiling point. This heating not only tends to promote the desired reaction between the added agents and certain constituents of the molasses, but also tends to sterilize the nutrient medium and possibly cause some modification of the constituents thereof so as to render them more readily assimilable when the solution is subsequently used in yeast manufacture.

After the heating has been continued for a sufficient time, as for example, from 1 to 2 hours the solution is allowed to stand until the larger part of the precipitate has settled whereupon the supernatent liquid is drawn off and filtered by any suitable means, as for example, through an ordinary filter press or a Sweetland filter preferably with the use of one of the usual filtering aids such as filtercel, kieselguhr, etc., used for example to the amount of about .5%.

Obviously the above procedure is merely illustrative of the way in which the present invention may be carried out and the materials used can be varied in the manner above set forth, for example, other alkaline compounds of ammonium or potassium or a mixture of such compounds may be used to render the raw materials alkaline and other suitable phosphorus containing materials such as phosphoric acid or potassium phosphate may be used to aid in the formation of the precipitate, the selection of the materials to be used being governed in accordance with the deficiencies of the raw material in the yeast-assimilable constituents afore-mentioned.

The present invention by one and the same treatment accomplishes not only elimination from commercial cane molasses of substances which tend to cause discoloration of yeast produced therefrom, but also may serve to introduce into the purified sacchariferous product at least a considerable proportion of the total quantity of yeast-assimilable nitrogen (and yeast-assimilable potassium also, if desired) necessary to constitute a well proportioned yeast nutrient with the sugar present. This enrichment of the purified molasses with yeast-assimilable nitrogen will take place as described notwithstanding the fact that some of the ammoniacal nitrogen which may be added in the form of ammonia or ammonium phosphate may enter into the composition of the precipitate which is separated from the purified molasses solution.

The yeast nutrient solution thus obtained may then be slightly acidified, for example, with sulphuric acid and may be either wholly or partially diluted to any suitable concentration and employed as a yeast nutrient solution, in any of the well known methods of manufacture utilizing aeration, for the commercial manufacture of bakers' yeast of good quality.

Moreover, if desired, the yeast-assimilable nitrogen content of the cane molasses purified and modified in accordance with my process taken either alone or with added malt sprouts, may be further augmented by causing to be commingled therewith further amounts of suitable substances containing yeast-assimilable nitrogen such as, for example, ammonium salts (as ammonium lactate, sulfate, phosphate, or carbonate), or compounds of an organic nature such as urea and the like. Obviously the commingling of the ammonium lactate may be accomplished if desired, by a controlled propagation of lactate acid bacteria in the solution with accompanying neutralization of the acid formed, by alkaline ammonium compounds, in any case the object being to form a yeast food well balanced with respect to its content of carbohydrate material and substances containing yeast-assimilable nitrogen and phosphorus.

When a bakers' yeast of a type or species such as is ordinarily employed in commercial yeast production is propagated in an aerated nutrient solution prepared in accordance with my present invention a yeast is obtainable on large scale commercial production which is of fully satisfactory keeping quality and baking strength and is fully satisfactory for marketing as a compressed bakers' yeast.

Since certain changes may be made in carrying out the above method without departing from the scope of the invention, it is intended that all matter contained in the above description shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a

matter of language, might be said to fall therebetween.

This application is in part a continuation of my copending application, Serial No. 597,145, filed October 26, 1922.

Having described my invention, what I claim as now, and desire to secure by Letters Patent, is:

1. A method of treating molasses adapted for use in the fermentation industries, which consists in rendering the molasses distinctly alkaline with an alkali compound containing yeast-assimilable components in which the molasses is deficient, adding thereto a substance adapted to form a phosphate precipitate, heating the mixture and thereafter separating the solution from the substances undissolved therein.

2. A method of treating molasses for use in the commercial manufacture of yeast by an aeration process which consists in rendering the molasses distinctly alkaline with an alkali compound containing yeast-assimilable components, adding thereto a phosphate precipitant, heating the mixture moderately and thereafter separating the solution from the substances undissolved therein, the alkali substance and the phosphorus containing substance being so selected and proportioned as materially to supply deficiencies of yeast-assimilable substances in the molasses.

3. A method of treating cane molasses for use in the commercial manufacture of yeast by an aeration process which comprises rendering the molasses distinctly alkaline with an alkali compound containing yeast-assimilable components in which the molasses is deficient, adding thereto a water-soluble phosphorus containing substance adapted to form a precipitate therein, heating the mixture moderately and thereafter separating the solution from the substances undissolved therein, the alkali and precipitating substances being selected from compounds of ammonium, potassium and phosphorus in such proportions as materially to supply the deficiencies of yeast-assimilable substances in the molasses.

4. A method of treating cane molasses for use in the manufacture of yeast by an aeration process, which comprises treating cane molasses with sufficient amounts of alkaline ammonium and potassium compounds to render it distinctly alkaline, adding thereto a water soluble phosphate containing essentially yeast-assimilable constituents, heating the mixture to approximately 80° C., and thereafter separating the solution from the substances undissolved therein.

5. A method of treating cane molasses for use in the manufacture of yeast by an aeration process, which comprises treating cane molasses with sufficient amounts of alkaline ammonium compounds to render it distinctly alkaline, adding thereto a water-soluble phosphate containing essentially yeast-assimilable constituents, heating the mixture to approximately 80° C., thereafter separating the solution from the substances undissolved therein.

6. A method of treating cane molasses for use in the manufacture of yeast by an aeration process, which comprises treating the molasses with sufficient ammonia to render it alkaline, adding an ammonium phosphate and thereafter separating the solution from substances undissolved therein.

7. A method of treating cane molasses for use in the manufacture of yeast by an aeration process, which comprises treating the molasses with sufficient ammonia to render it alkaline, adding an ammonium phosphate, heating the mixture to approximately 80° C., and thereafter separating the solution from substances undissolved therein.

8. A method of treating cane molasses for use in the manufacture of yeast by an aeration process, which comprises treating the molasses with sufficient ammonia to render it alkaline, adding a quantity of ammonium dihydrogen phosphate equivalent to about 1 per cent of the weight of the molasses originally taken for treatment and thereafter separating the solution from substances undissolved therein.

9. A method of treating cane molasses for use in the manufacture of yeast by an aeration process, which comprises treating the molasses with sufficient ammonia to render it alkaline, adding a quantity of ammonium dihydrogen phosphate equivalent to about 1 per cent of the weight of the molasses originally taken for treatment, heating the solution to approximately 80° C., and thereafter separating the solution from substances undissolved therein.

10. A sacchariferous aqueous solution adapted to be used as a yeast nutrient medium in the production of bakers' yeast by an aeration process, said solution being free from substances causing discoloration of yeast and containing the water soluble constituents of the reaction products of cane molasses, ammonia present in sufficient amounts to render the solution distinctly alkaline and an ammonium phosphate.

11. A sacchariferous aqueous solution adapted to be used as a yeast nutrient medium in the production of bakers' yeast by an aeration process, said solution being free from substances causing discoloration of yeast and containing the water-soluble constituents of the reaction products of cane molasses, ammonia and an ammonium phosphate, together with an admixture of aqueous malt sprout extract.

12. A method of treating cane molasses for use in the manufacture of yeast by an aeration process, which comprises treating

cane molasses with re-agents containing yeast assimilable components and which are capable of both freeing the molasses from yeast-discoloring substances and of forming with the molasses residue a substantially balanced yeast ration and filtering the treated molasses.

13. A method of treating cane molasses for use in the manufacture of yeast by an aeration process, which comprises treating cane molasses with re-agents containing yeast assimilable nitrogen and phosphorus in such proportions as to free the molasses from yeast-discoloring substances and to form with the molasses residue a substantially balanced yeast ration, and filtering the treated molasses.

14. A method of treating cane molasses for use in the manufacture of yeast by an aeration process, which comprises rendering the molasses alkaline by the addition of an alkali compound containing yeast-assimilable nitrogen, precipitating from the molasses the yeast-discoloring substances by the addition of substances containing yeast-assimilable phosphorus, and thereafter separating the undissolved substances from the solution, such materials and re-agents being used in such proportions that the resultant medium comprises a substantially balanced yeast ration.

15. A method of treating cane molasses for use in the manufacture of yeast by an aeration process, which comprises rendering the molasses alkaline by the addition of an alkali compound containing yeast-assimilable nitrogen, precipitating from the molasses the yeast-discoloring substances by the addition of substances containing yeast-assimilable phosphorus, separating the undissolved substances from the solution and subsequently rendering the medium slightly acid by the addition of sulphuric acid.

In testimony whereof I affix my signature.

FRED RANSOHOFF.

DEFENDANT'S EXHIBIT D-9

Date Received
September 17, 1925.

Laboratory No. 2652.

C B 6 WASH NO. 17-4

Fermenter No. 16. Plant No. 1.

Sample	BALLING. before filtration	BALLING. after filtration	P_2O_5 in Beer. Grape 100cc	Alcohol in Beer (Proof spirit)	Dried Yeast Grams per Liter	Nitrogen in Dried Yeast	Calls.	Diff.
start								
1:15 P.M.	1.5	1.0	.080	0.0	4.67 grs.	8.61%	8398	
2:15 "	2.0	0.9	.075	0.0	5.30	8.42%	8538	140
3:15 "	1.8	1.0	.070	0.0	6.99	8.70%	9308	330
4:15 "	2.1	1.1	.050	0.0	9.18	8.75%	9788	480
5:15 "	2.4	1.3	.022	0.0	11.20	8.37%	9828	520
6:15 "	2.6	1.5	.006	0.0	13.92	8.42%	10468	640
7:15 "	2.9	1.6	.002	0.0	14.97	Spoiled	11208	740
8:15 "	3.2	1.8	.0015	0.0	16.60	8.91%	12000	792
9:15 "	3.3	1.7	.0010	0.0	16.90	9.09%	12000	
10:15 "	3.2	1.8	.0018	0.0	16.30	7.39%		

Balling tests by Mr. Browne.

P_2O_5 test by Mr. Roake.

Alcohol by Mr. Streng

Beer was filtered through alundum crucibles, by Mr. Browne.

Nitrogen tests by Mr. Browne.

CHARLES S. ROAKE,
Sept. 28, 1925.

CSR

DEFENDANT'S EXHIBIT D-9-A.

Date Received.
September 18, 1925.

Laboratory No. 2674.

C B & W A S H N O. 18-2.

Fermenter No. 15. Plant No. 1.

Sample	BALLING. before filtration	BALLING. after filtration	P_2O_5 in Beer. Grs. per 100 cc	Alcohol (Proof Spirit)	Dried Yeast Nitrogen Grams per liter.	in Dried Yeast	Cells.	Diff.
Start								
18. M.	1.52	1.00	.090	0.0%	5.348	8.52%	8530	
2 "	1.80	1.00	.085	0.2	6.087	9.15%	8660	130
3 "	1.78	1.02	.080	0.0	7.396	8.00%	8990	330
4 "	1.90	1.13	.070	0.0	7.476	9.66%	9390	400
5 "	2.15	1.35	.030	0.0	9.042	Spoiled	9990	500
6 "	2.35	1.35	.0055	0.8	12.347	8.39%	10510	620
7 "	2.66	1.40	.0018	0.0	13.735	Spoiled	11230	720
8 "	2.76	1.57	.0010	0.0	15.306	8.96%	12000	770
9 "	2.97	1.58	.0005	0.0	15.126	Spoiled	13000	

Alcohol tests by Mr. Strang.

Above filtered through alundum crucibles by Mr. Roake.

CHARLES T. ROAKE.
Sept. 26,1925.

C T R

DEFENDANT'S EXHIBIT D-9-B.

2674. September 21, 1925. Lab. Number 2637.

SPECIAL TEST ON MASH #12-B

Fermenter #9 Plant #2.

Time	Gallons	Difference	Mg. before filtration	Mg. after filtration	Alcohol	Dried Yeast in 1 liter	Nitrogen in Dried Yeast
10 A.M.	10304		1.55	1.10	zero	5.00 gms.	8.40%
11 "	10320	65	1.55	1.10	"	6.20 "	8.51%
12 "	10524	165	1.75	1.20	"	8.25 "	8.54
1 P.M.	10724	200	1.95	1.25	"	9.45 "	8.40
2 "	10974	250	2.25	1.35	"	10.95 "	8.40
3 "	11294	310	2.70	1.70	"	11.20 "	8.25
4 "	11644	360	2.90	1.75	"	14.10	8.06
5 "	12054	410	3.20	1.90	"	16.50 "	7.94
6 "	12064		3.30	1.95	"	16.60 "	8.13
7 "	12054		3.30	1.95	"	16.82 "	8.06

Average Moisture about 76%

Dr. Fred Post.

Corrected copy
Charles C Roate.

DEFENDANT'S EXHIBIT D-9-C.

September 18, 1925. Lab. No. 2637.

SPECIAL TEST ON YEAST # 12-2
Form. #9 from Plant # 2, Peekskill.

Time	Gals.	Difference	Sltg. before filtration	Sltg. after filtration	Alcohol	Dried yeast in 1 liter	Nitrogen in Dried Yeast.	Time
10 A.M.	10296		1.35	1.10	zero	5.0 gms.	5.63%	10 A.M.
11 "	10350	65	1.35	1.10	"	6.20 "	5.72	11 "
12 "	10524	165	1.75	1.20	"	8.25 "	4.24	12 "
1 P.M.	10724	200	1.95	1.25	"	9.45 "	5.25	1 P.M.
2 "	10974	250	2.25	1.35	"	10.95 "	5.25	2 "
3 "	11284	310	2.70	1.70	"	11.20 "	5.36	3 "
4 "	11644	360	2.90	1.75	"	14.10 "	6.04	4 "
5 "	12054	410	3.20	1.90	"	16.30 "	4.88	5 "
6 "	12054		3.30	1.95	"	16.90 "	5.88	
7 "	12054		3.30	1.95	"	14.82 "	5.04	

Moisture about 76%

Dr. Fred Peet.

Chas E Roake
Sept 15, 1925

DEFENDANT'S EXHIBIT D-9-D.

September 3, 1925. LAB. NO. 3612.

CB5

SPECIAL TEST ON STOCK MASH #6-4.
Form. #32 from Plant #2, Peekskill.

Time	Sale.	Difference	Mfg. before filtration	Mfg. after filtration	Alcohol	Dried Yeast in 1 liter		Nitrogen in Dried Yeast
10 A.M.	10283		1.70	1.30	sore	7.7 gms.		8.82
11 "	10473	-160	1.75	1.30	"	50% 4.8	= 1.3	8.58
12 "	10663	210	1.75	1.30	.2% Peroxide	36% 5.4	= 1.2	9.23
1 P.M.	10963	300	1.75	1.30	.2% "	6.6	= 1.2	9.30
2 "	11253	310	1.90	1.35	.4% "	34% 8.3	= 1.7	9.25
3 "	11613	360	2.00	1.40	.4% "	25% 10.4	= 2.1	9.25
4 "	12013	420	2.45	1.60	.2% "	17% 12.2	= 1.8	9.38
5 "	12613		2.45	1.60	sore	6.5% 83.8	= .80	9.23

Average Moisture 76%

15.9% N.

Dr. Fred Peet.

Charles Reed
Sept 8, 1925

14
4.5%

DEFENDANT'S EXHIBIT D-9-E.

Lab. No. 2305.

August 28, 1925.

SPECIAL TEST ON WASH # 28-2
Form. # 18. Plant # 2.

Time	Galls.	Diff.	Balling before fermentation	Balling after fermentation	Alcohol	Dried Yeast in 1 liter	Nitrogen in Dried Yeast
9 A.M.	10363		1.60	1.10	zero	4.10 grs.	9.27%
10 "	10441.5	78.5	1.60	1.15	= 30%	5.30 = 1.20	9.07
11 "	10592	150.5	1.80	1.20	= 34%	7.10 = 1.80	9.27
12 "	10795	203.0	2.05	1.30	= 28%	9.10 = 2.00	8.96
1 P.M.	11006	211.0	2.35	1.50	= 10%	10.00 = .90	9.38
2 "	11315	309.0	2.65	1.65	= 13%	11.30 = 1.30	9.07
3 "	11677	362.0	2.95	1.85	= 9.7%	14.40 = 1.10	9.24
4 "	12055	378.0	3.15	1.95	= 14%	16.45 = 2.05	8.96
5 "	12055	---	3.20	1.95	= 3%	16.95 = .500	9.16

3
11) 1200

Dr. Fred Past.

Moisture Average about 75.5%

.34 Charles E Roatn
aug 28, 1925

53) 180
159
210
211

.81
11) 200
102
580
568
120

97
11.3) 1100
1017
830
14
144) 2050
144
610
576

DEFENDANT'S EXHIBIT D-9-F.

Date Received.
September 15, 1925.

Laboratory No. 2672.

C B 6 W A S H NO. 15-3.

Fermenter No. 16. Plant No. 1.

Sample	BALLING. before filtration	BALLING. after filtration	P_2O_5 in Beer Gms. per 100 c.c.	Alcohol in Beer (Proof Spirit)	Dried Yeast Gms. per Liter	Nitrogen in Dried Yeast	Gals.	Diff.
at start	1.55	1.10	.070	0.0%	3.2898	9.26%	8580	
1st hr.	1.56	1.05	.050	0.2%	4.6964	8.49%	8880	130
2nd "	1.65	1.16	.045	0.2	4.5081	9.77	8990	330
3rd "	1.80	1.30	.053	0.2	6.7656	9.68	9390	400
4th "	2.65	1.35	.028	0.0	8.7460	9.32	9890	500
5th "	2.85	1.40	.023	0.0	10.7787	9.26	10510	620
6th "	2.56	1.54	.004	0.0	11.5822	9.20	11230	720
7th "	2.65	1.61	less than .002	0.0	10.2354 (c)	9.27	12000	770
8th "	2.75	1.55	less than .002	0.0	13.1167	spoiled	12000	
	Above tests by Mr. Tomkin		Tested by Mr. Strang		Tested by Mr. Reake.		Tested by Mr. Reake.	

In 7th hour high balling after filtering and apparently low yield of yeast were probably caused by an imperfect filtration as the buchner funnels are not very efficient. In the latter experiments similar crucibles were used to secure a better filtration.

CHARLES E. REAKE.
Sept. 26, 1925.

CLR

DEFENDANT'S EXHIBIT D-9-G.

September 14, 1925. Laboratory No. 2671

WASP CB 14-3.

REMEDIES NO. 16. PLANT NO. 1.

Sample	BALLING. before filtration	after filtration	Alcohol (Proof Spirit)	Dried Yeast Gr. per liter	Nitrogen in Dried Yeast	Galls.	Diff.
at start	1.50	1.05	0.0%	2.8900 gr.	7.89% N	8530	
1st hr.	1.55	1.02	0.2%	4.4812 gr.	8.96% N	8660	130
2nd "	1.55	1.05	0.2	5.4593	9.72%	8990	330
3rd "	1.65	1.30	0.0	6.3013	9.70%	9390	400
4th "	2.0	1.37	0.0	7.1557	9.38%	9890	500
5th "	2.30	13.6	0.0	9.6087	9.25%	10510	620
6th "	2.46	1.75	0.0	10.1807	9.29%	11230	720
7th "	2.70	1.75	0.0	12.3675	8.69%	12000	770
8th "	2.75	1.55	0.0	14.1763	8.52%	12000	

Alcohol Tests
by
Mr. Strang.

Charles T. Rents.

Sept. 26, 1925.

CER

DEFENDANT'S EXHIBIT D-9-H.

24

Date Received
Sept. 17, 1925.

Laboratory No. 3673.

3671

C B & WASH NO. 17-3

Fermenter No.15. Plant No. 1.

Sample	BALLING. before filtration	BALLING. after filtration	P.O.in Beer gr per 100 cc	Alcohol in Beer (Proof Spirit)	Dried Yeast Grams per Liter	Nitrogen in Dried Yeast	Gallo.	Difference.
Start	1.50	1.05	.090	0.0	3.7680	9.35%	8398	
1st hr.	1.65	1.00	.080	0.0	4.9994	10.07%	8838	140
2nd "	1.65	1.05	.075	0.0	5.3200	10.21%	8888	350
3rd "	1.77	1.25	.072	0.0	6.1526	10.14%	9308	420
4th "	2.10	1.30	.060	0.0	7.7500	9.96%	9828	520
5th "	2.26	1.35	.025	0.0	9.3030	9.71%	10468	640
6th "	2.97	1.36	.005	0.0	12.0800	9.51%	11208	740
7th "	2.87	1.65	.003	0.0	13.5200	Spoiled	12000	793
8th "	3.05	1.70	.0038	0.0	13.8800	8.73%	13000	
9th "	3.05	1.76	.0015	0.0	14.7580	8.30%		

Alcohol tests
by
Mr. Strang.

CHARLES V. NOAKY.

Sept. 26, 1925.

C & R

DEFENDANT'S EXHIBIT D-10.

Chart A

pH scale and Hydrogen ion concentration

pH		H ions (in units of grams x 10^{-7} per liter)
3.0		10,000
3.1 →		← 7943
3.6		3,163
4.0		1,000
Dr Lamb. .27 { 4.23 →		← 590
4.5		316
.1 { 4.6 →		← 251
Dr Fuller		
5.0		100
5.5		32
6.0		10
7.0		1

Dept of E

DEFENDANT'S EXHIBIT D-11.

Record of Prior Trials Including Pleadings and Exhibits.

(Physical Exhibit.)

STIPULATION AS TO RECORD.

It Is Hereby Stipulated and Agreed, by and between counsel for the respective parties hereto, that the foregoing transcript in two volumes is a true transcript of the record of the United States District Court for the District of New Jersey, in the above-entitled case, as agreed by the parties.

.....

Of Counsel for Plaintiff-Appellant.

Dated:

.....

Of Counsel for Defendant-Appellant.

Dated:

CLERK'S CERTIFICATE.

I, GEORGE T. CRANMER, Clerk of the District Court of the United States of America for the District of New Jersey, do hereby certify that the foregoing is a correct transcript of the record (in two volumes) of the said District Court in the above-entitled matter as agreed on by the parties.

IN TESTIMONY WHEREOF, I have caused the seal of said Court to be hereunto affixed, at the City of Trenton, in the District of
(Seal) New Jersey, this day of , in the year of our Lord one thousand nine hundred and thirty-eight, and of the Independence of the said United States the one hundred and sixty-second.

GEORGE T. CRANMER,
Clerk.

CLERK'S CERTIFICATE.

UNITED STATES OF AMERICA,
EASTERN DISTRICT OF PENNSYLVANIA, } *Sct.:*
THIRD JUDICIAL CIRCUIT.

I, Wm. P. Rowland, Clerk of the United States Circuit Court of Appeals for the Third Circuit, DO HEREBY CERTIFY the foregoing to be a true and faithful copy of the original Transcript of Record, Volume II (Exhibit Book) in the cases of Standard Brands, Inc., Plaintiff-Appellant, v. National Grain Yeast Corp., Defendant-Appellee, No. 6651; National Grain Yeast Corp., Defendant-Appellant, v. Standard Brands, Inc., Plaintiff-Appellee, No. 6670, on file, and now remaining among the records of the said Court, in my office.

IN TESTIMONY WHEREOF, I have hereunto subscribed my name and affixed the seal of the said Court, at Philadelphia, this twentieth day
(Seal) of February, in the year of our Lord one thousand nine hundred and thirty-nine and of the Independence of the United States the one hundred and sixty-third.

WM. P. ROWLAND,
Clerk of the U. S. Circuit Court of Appeals, Third Circuit.

SUPREME COURT OF THE UNITED STATES

ORDER ALLOWING CERTIORARI—Filed March 27, 1939

The petition herein for a writ of certiorari to the United States Circuit Court of Appeals for the Third Circuit is granted, limited to the question of the validity of Hayduck Patents Nos. 1,449,103; 1,449,105; and 1,449,106.

And it is further ordered that the duly certified copy of the transcript of the procedings below which accompanied the petition shall be treated as though filed in response to such writ.

FILE COPY

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CLERK

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IN THE

Supreme Court of the United States

OCTOBER TERM—1938

No. 701

STANDARD BRANDS INCORPORATED,
Petitioner,

vs.

NATIONAL GRAIN YEAST CORPORATION,
Respondent.

PETITION FOR WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE THIRD CIRCUIT, AND SUPPORTING BRIEF

LEONARD A. WATSON,
CLAIR V. JOHNSON,
CHARLES P. BAUER,
Counsel for Petitioner.

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IN THE

Supreme Court of the United States

OCTOBER TERM 1938

No.

STANDARD BRANDS INCORPORATED,
Petitioner,

vs.

NATIONAL GRAIN YEAST CORPORATION,
Respondent.

PETITION FOR WRIT OF CERTIORARI.

TO THE HONORABLE CHIEF JUSTICE AND ASSOCIATE JUSTICES OF THE SUPREME COURT OF THE UNITED STATES:

Your petitioner, Standard Brands Incorporated, respectfully prays for a writ of certiorari to the United States Circuit Court of Appeals for the Third Circuit to review the judgment of that Court entered on February 1, 1939.

A certified transcript of the record in the case, including the proceedings in said Circuit Court of Appeals, is furnished herewith in accordance with Rule 38 of this Court.

Summary and Statement of Matter Involved.

1. This is a patent infringement suit for an injunction and accounting. Five patents were in suit, each relating to a process of manufacturing compressed yeast which is used by bakers as a leavening agent for bread and like bakery products. Both petitioner and respondent manufacture and sell such yeast to bakers.

2. The Circuit Court of Appeals for the Third Circuit, reversing the trial Court, found invalid the issue claims of Hayduck patent 1,449,103 (all of the fifteen claims except Claims 5 and 6) (R. I, 671-680).

In a prior suit by petitioner against another defendant, the Circuit Court of Appeals for the Fourth Circuit affirmed a decree holding valid the same claims, except Claims 9, 10 and 11 not there in issue (*Fleischmann Yeast Co.* v. *Federal Yeast Corporation,* 13 F. (2d) 570, affirming 8 F. (2d) 186; *cf.* accounting proceedings reported at 38 F. (2d) 315).

3. The Circuit Court of Appeals for the Third Circuit found invalid all ten claims of Hayduck patent 1,449,105 (R. I, 681-683), and the issue claims of Hayduck patent 1,449,106 (Claims 1, 3, 4, 5, 6, 8, 12, 13 and 15) (R. I, 683-684).

In a prior suit by petitioner against another defendant, the District Court for the District of Maryland held valid Claims 4, 8, 9 and 10 of Hayduck patent 1,449,105, and all of the above enumerated claims of Hayduck patent 1,449,106, except Claim 15 not there in issue (*Standard Brands, Inc.* v. *Federal Yeast Corporation* 38 F. (2d) 329); after which the defendant settled for the infringement and withdrew its appeal.

4. The reported decisions on these three Hayduck patents* pay tribute to the demonstrated commercial success and industrial importance of these inventions which revolutionized the yeast manufacturing industry.

The records in both the previous and the present litigation show that despite constant efforts to improve yeast

* Another Hayduck patent, 1,449,109, and a Corby *et al.* patent, 1,673,735, also in suit, have not been previously adjudicated and while this petition is not based thereon, petitioner feels that the Circuit Court of Appeals for the Third Circuit was in error in holding the issue claims thereof invalid, and prays that in granting this petition the entire controversy will be considered by this Court.

yield and quality, the highest yield of good quality yeast obtainable prior to Hayduck was 35% on the raw materials (R. I, 99-100); that the specific process of Hayduck patent 1,449,103 almost doubled the yield and effected many important savings (8 F. (2d) 186, 188*); that and the processes of Hayduck patents 1,449,105 and 1,449,106 afforded commercial yields of 80% and over with additional savings (38 F. (2d) 329, 337; R. I, 102-105).

The Record below also shows that petitioner has extensively used the inventions of these patents and that at the date of the trial, October 1935, it had already manufactured and sold over 2 billion pounds of bakers' yeast under Hayduck patent 1,449,103, of which about 1¾ billion pounds utilized the inventions covered by Hayduck patents 1,449,105 and 1,449,106 (R. I, 104-105).

Reasons Relied Upon for the Grant of the Writ of Certiorari.

The discretionary power of this Court to grant a writ of certiorari is invoked upon the following grounds:

1. The decision of the Circuit Court of Appeals for the Third Circuit, in the instant case, is in conflict with a decision of the Circuit Court of Appeals for the Fourth Circuit on the question of validity of Hayduck patent 1,449,103; and is also in conflict with the decision of the trial Court on this matter.

2. The decision of the Circuit Court of Appeals for the Third Circuit, in the instant case, is in conflict with the decision of the District Court for the District of Maryland on the question of validity of Hayduck patents 1,449,-

* The District Court for the District of Maryland described this change as "revolutionary"; the Circuit Court of Appeals for the Third Circuit also so described it (R. I., 672) but failed to appreciate that it was Hayduck's invention.

105 and 1,449,106. These patents were issued to the same inventor on the same day as patent 1,449,103, and the subjects matter thereof and the record not only in the present but in the previous litigation, are so interrelated as to warrant the granting of this petition as to all three, even though as to the last two there is no conflict between Circuit Courts of Appeals.

3. The decision herein of the Circuit Court of Appeals for the Third Circuit to the effect that Hayduck patents 1,449,103 and 1,449,105, may be used as prior art against Hayduck patent 1,449,106 even though they were issued to the same applicant, do not claim the same invention, were all copending in the Patent Office, and issued on the same date; is in direct conflict with the weight of authority, and is an important question of general patent law.

WHEREFORE, your petitioner respectfully prays that a writ of certiorari be issued to the United States Circuit Court of Appeals for the Third Circuit to the end that this cause may be reviewed and determined by the Court, that the judgment of the Circuit Court of Appeals be reversed; and that petitioner be granted such other and further relief as may seem proper.

LEONARD A. WATSON,
CLAIR V. JOHNSON,
CHARLES P. BAUER.
Counsel for Petitioner.

We hereby certify that we have examined the foregoing petition and in our opinion the petition is well founded, and that the case is one in which the prayer of the petition should be granted by this Court.

LEONARD A. WATSON,
CLAIR V. JOHNSON,
CHARLES P. BAUER.
Counsel for Petitioner.

BRIEF IN SUPPORT OF PETITION FOR WRIT OF CERTIORARI.

Opinions of the Courts Below.

The opinion of the trial court below is reported at 21 F. Supp. 46 and is found at R. I, 626; the opinion of the Circuit Court of Appeals for the Third Circuit is not yet reported in the Federal Reporter, but is found at 40 U. S. P. Q. 318 and at R. I, 668.

The opinion of the District Court for the District of Maryland in *Fleischmann Yeast Co.* v. *Federal Yeast Corporation,* involving patent 1,449,103, is reported at 8 F. (2d) 186; the affirming opinion of the Circuit Court of Appeals for the Fourth Circuit is reported at 13 F. (2d) 570; and the District Court's opinion in the accounting proceedings is reported at 38 F. (2d) 314.

The opinion of the District Court for the District of Maryland in *Standard Brands Inc.* v. *Federal Yeast Corporation,* involving patents Nos. 1,449,105 and 1,449,106, is reported at 38 F. (2d) 329.

Jurisdiction.

The grounds of jurisdiction are:

(1) The date of the judgment to be reviewed is February 1, 1939.

(2) The judgment was rendered in a suit in equity brought under the patent statutes to determine the issues of validity and infringement of Letters Patent.

(3) The statute under which jurisdiction is invoked is Section 240(a) of the Judicial Code (28 U. S. C. Sec. 347) as amended.

Statement of the Case.

The facts are sufficiently stated in the accompanying petition for writ of certiorari.

Specification of Errors.

The errors which petitioner will urge if the writ of certiorari is granted are that the Circuit Court of Appeals for the Third Circuit erred,

(1) In holding the issue claims of the patents in suit invalid.

(2) In failing to hold the issue claims of the patents in suit valid and infringed.

Argument.

(1) All of the claims except Claims 5 and 6 of Hayduck patent 1,449,103 were here in suit and were held invalid by the Circuit Court of Appeals for the Third Circuit. Of these, Claims 1, 2, 3, 4, 7, 8, 12, 13, 14 and 15 were previously litigated and held valid by the Circuit Court of Appeals for the Fourth Circuit. Hence the conflict between the decisions of the Circuit Courts of Appeals for the Third and Fourth Circuits is direct and complete.

(2) All of the claims of Hayduck patent 1,449,105 and the issue claims of Hayduck patent 1,449,106 (Claims 1, 3, 4, 5, 6, 8, 12, 13 and 15) were held invalid by the Circuit Court of Appeals for the Third Circuit. Claims 4, 8, 9 and 10 of Hayduck patent 1,449,105, and all of the enumerated claims of Hayduck patent 1,449,106, except Claim 15 not there in issue, were previously litigated and held valid by the District Court for the District of Maryland. At the same time, that District Court handed down its opinion in the accounting proceedings of the

previous litigation*, awarding damages at the rate of $.025 per pound of infringing yeast. Defendant filed appeals from both these decisions but later withdrew them and settled for its violation of petitioner's patents by payment of a substantial sum of money.

The conflict between the decisions of the Circuit Court of Appeals for the Third Circuit and the District Court of Maryland on the validity of Hayduck patents 1,449,105 and 1,449,106 and on the scope of Hayduck patent 1,449,103 is also direct and complete.

These three patents are used in combination by both petitioner and respondent and are closely interrelated. They all issued on the same day, are based on applications filed by the same inventor (Hayduck) and are appropriately cross referenced, in that patent 1,449,106 refers to the applications for patents 1,449,105 and 1,449,103 (R. II, 8).

Thus the conflict between two Circuit Courts of Appeals as to patent 1,449,103 should suffice for this Court to grant certiorari as to all three of these Hayduck patents, if not to all five patents in suit.

(3) It is believed that certiorari should be granted as to Hayduck patent 1,449,106 for an additional reason, namely: The Circuit Court of Appeals for the Third Circuit, after finding Hayduck patents 1,449,103 and 1,449,105 invalid, held as to Hayduck patent 1,449,106:

> "It is stipulated by the parties that this patent combines the processes of Hayduck -103, including the principle of neutralization, and the processes of Hayduck -105, including the regulated rate of feeding the nutrient solution. Since we have found patents Hayduck -103 and Hayduck -105 to be invalid it fol-

* The opinion in the accounting proceedings also holds *contra* to the present Courts below on the question of infringement of Hayduck patent 1,449,103 by certain procedural steps.

> lows that we find this patent to be invalid since combining the processes of invalid process patents cannot result in validity" (R. I, 683-684).

The Circuit Court of Appeals thus fell into the same error that the District Court had made (R. I, 634), namely, the error of law in treating Hayduck's patent 1,449,103 and 1,449,105 as prior art against his patent 1,449,106 when the fact is that they do not claim the same invention, were all copending in the Patent Office, and issued on the same date.

This decision is thus in direct conflict with the decisions of this Court dating as far back as *Loom Co.* v. *Higgins*, 105 U. S. 580, 591 (1881) and *The Suffolk Co.* v. *Hayden*, 70 U. S. 315, 319 (1865).

In using Hayduck's copending, but earlier filed, applications as prior art the Circuit Court of Appeals for the Third Circuit has not only disregarded its former decisions, *c. f. Elevator Supplies Co.* v. *Graham & Norton Co.*, 44 F. (2d) 358, 361-62, but has also decided contrary to the Circuit Courts of Appeals of other circuits as summarized by the decision of the District Court for the District of Maryland treating the same defenses in the case of *Standard Brands Incorporated* v. *Federal Yeast Corporation*, 38 F. (2d) 329, 343-343. The District Court for the District of Connecticut perhaps most aptly characterized the defense, in the case of *American Hatters & Furriers Co.* v. *Danbury & Bethel Fur Co.*, 47 F. (2d) 268, 269:

> "It seems clear that one (patent) could not be found invalid in view of the prior art and then used to invalidate the other, as we are bound by the decision of the Circuit Court of Appeals for the Second Circuit in *H. C. White Co.* v. *Morton E. Converse & Son Co.*, 20 F. (2d) 311. Such a procedure, apparently urged by the defendant, is repugnant to equity."

Conclusion.

Wherefore petitioner earnestly prays that the petition for writ or certiorari be granted.

Respectfully submitted,

LEONARD A. WATSON,
CLAIR V. JOHNSON,
CHARLES P. BAUER,
Counsel for Petitioner.

Dated, February 24th, 1939.

FILE COPY

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IN THE

Supreme Court of the United States

OCTOBER TERM—1938

No. ~~701~~ 9

STANDARD BRANDS INCORPORATED,
Petitioner,

vs.

NATIONAL GRAIN YEAST CORPORATION,
Respondent.

PETITIONER'S REPLY TO RESPONDENT'S BRIEF ON PETITION FOR WRIT OF CERTIORARI

LEONARD A. WATSON,
CLAIR V. JOHNSON,
CHARLES P. BAUER,
Counsel for Petitioner.

Post Printing Company, Inc., 80 Lafayette Street, New York, N. Y.

IN THE

Supreme Court of the United States

OCTOBER TERM—1938

No. 701

STANDARD BRANDS INCORPORATED,
Petitioner,

vs.

NATIONAL GRAIN YEAST CORPORATION,
Respondent.

PETITIONER'S REPLY TO RESPONDENT'S BRIEF ON PETITION FOR WRIT OF CERTIORARI

I. Patent 1,449,103 has been held valid by the Circuit Court of Appeals for the Fourth Circuit, and the Federal Yeast Corporation of Baltimore is under injunction which prohibits infringement. The patent has been held invalid by the Circuit Court of Appeals for the Third Circuit and respondent is thus permitted to do what the Federal Yeast Corporation is enjoined from doing.

Examination of the conflicting decisions in the two cases shows squarely opposing judicial conclusions, which constitute "a real and embarrassing conflict" whether considered from the business viewpoint of the large industry involved or from the public viewpoint of respect for orderly judicial process.

No case is cited by respondent or known to petitioner where certiorari has been denied in such a situation. In the case of *Layne & Bowler Corporation* v. *Western Well Works Inc. et al.* (261 U. S. 387) cited by respondent, there was no such conflict and the case is not in point.

Respondent's suggestion that the writ of certiorari should be limited to the question of validity and exclude the question of infringement is a mere plea for dilatory and piecemeal consideration. On the question of infringement there is also judicial conflict between the District Court in New Jersey (21 F. Supp. 46-47) and the District Court in Maryland (38 F. (2d) 329, 350-351). If the patent is to be reviewed by this Court, then this Court's final judgment should settle both the issues of validity and infringement, which are directly involved.

II. As to the -105 and -106 patents held invalid below and held valid by the District Court of Maryland, we point out the following.

The reality of judicial conflict appears incontrovertibly from reading the divergent opinions. To avoid review by this Court, respondent accordingly relies on the argument that the Baltimore litigation ended by settlement after the decision of the District Court whereas the decision below herein is that of a Circuit Court of Appeals.

The Baltimore settlement, however, included the payment of a large sum by defendant as damages, and the settlement was at the instance of defendant not of plaintiff. Accordingly, it is believed that the denial, on the above ground, of the writ as to patents -105 and -106 would amount to a tacit expression by this Court of a rule constituting an effective deterrent to settlement of litigation by a plaintiff successful in the trial court in a patent case. These patents now stand finally adjudicated valid in Maryland, where the Federal Yeast Corporation is under injunction also as to them, and invalid in New Jersey. The disparity is not conducive to the interests of the several parties nor of the public, and should be corrected in the only manner possible, namely, by review by this Court.

III. Pages 5 to 12 of respondent's brief, which are devoted to argument on the merits of the patents in suit should be disregarded because such argument is not deemed in order on the initial questions of whether there is conflict of opinion and whether the writ should be granted. It is not understood that full briefs on the issues of validity and infringement of patents are called for on petitions for writ of certiorari in cases where conflict of decision is present. Respondent's argument should also be disregarded, because petitioner flatly denies the truth of many of the statements of alleged fact therein.

IV. We respectfully pray that the petition for certiorari be granted.

Respectfully submitted,

LEONARD A. WATSON
CLAIR V. JOHNSON
CHARLES P. BAUER.

March 17, 1939.

FILE COPY

SEP 19 1939
CHARLES ELMORE CROPLEY
CLERK

IN THE

Supreme Court of the United States

OCTOBER TERM—1939

No. 9

STANDARD BRANDS INCORPORATED,

Petitioner,

vs.

NATIONAL GRAIN YEAST CORPORATION;

Respondent.

BRIEF FOR PETITIONER

LEONARD A. WATSON,
CLAIR V. JOHNSON,
Counsel for Petitioner.

Post Printing Company, Inc., 80 Lafayette St., New York, N. Y.

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IN THE

Supreme Court of the United States

OCTOBER TERM—1939

No. 9

STANDARD BRANDS INCORPORATED,
Petitioner,

vs.

NATIONAL GRAIN YEAST CORPORATION,
Respondent.

BRIEF FOR PETITIONER

This Petition for Writ of Certiorari to the United States Circuit Court of Appeals for the Third Circuit involves three Hayduck patents, numbered 1,449,103, 1,449,105 and 1,449,106, owned by petitioner. For convenience, these will hereafter be referred to by their last three digits, as –103, –105, and –106.

The Petition was granted only as to the question of validity of each patent.

OPINIONS BELOW REPORTED

The opinion of the Circuit Court of Appeals below (Biggs, *C. J.*) is reported at 101 F. (2d) 814 and is found at R. I., 668; the opinion of the trial Court (Fake, *D. J.*) is reported at 21 F. Supp. 46 and is found at R. I, 626.

The conflicting opinion of the Circuit Court of Appeals for the Fourth Circuit on patent –103 in *Federal Yeast Corporation* v. *Fleischmann Co.*, is reported at 13 F. (2d) 570; affirming the trial Court's opinion (Soper, *D. J.*) in *Fleischmann Yeast Co.* v. *Federal Yeast Corporation*, reported at 8 F. (2d) 186. The latter Court's opinion on the accounting is reported at 38 F. (2d) 314.*

The conflicting opinion of the same District Court on patents –105 and –106 in *Standard Brands, Inc.* v. *Federal Yeast Corporation*, is reported at 38 F. (2d) 329.**. This opinion was handed down simultaneously with that in the accounting proceedings on patent –103 and shortly thereafter the entire litigation in Maryland was ended by settlement in which the defendant was enjoined from further infringement of the three patents and made payment to petitioner of a large sum of money for past infringement.

JURISDICTION

The grounds on which jurisdiction of this Court is invoked are:

(1) The conflict of decisions noted above.

(2) The decision of the Circuit Court of Appeals, for the Third Circuit in the instant case to the effect that patents –103 and –105 may be used as prior art against patent –106, (even though they were filed by the same applicant, claim distinct inventions and issued on the same date) is in direct conflict with the weight of authority and is an important question of general patent law.

---

* This will be hereinafter referred to as the "first Maryland litigation". Petitioner is the successor in business to the Fleischmann Yeast Company.

** This will be hereinafter referred to as the "second Maryland litigation".

STATEMENT OF THE CASE

The three patents claim novel and commercially important processes of manufacturing compressed yeast which is used by bakers as a leavening agent for bread and like bakery products. The patented inventions are capable of conjoint use and have been so used by petitioner.

The following general statement of Judge Soper of what yeast is and how it is grown is concise and not in dispute.

> "The product [bakers' yeast], which is used in the baking industry, must possess special qualities and properties. * * * Bakers' yeast forms the right amount of gas, is favorable to the texture of the bread, and does not have an offensive taste or odor. It is of suitable color. Moreover, it has lasting qualities, while many other varieties rapidly deteriorate and become a slimy unattractive mass, unsuitable for bread making.
>
> Yeast is a small cellular micro-organism. In its ordinary significance, it is a conglomerate mass of infinitesimally small cells. It multiplies by self propagation, limited by the means of subsistence, and the quality and yield are greatly affected by the conditions under which propagation is carried on. Yeast has been manufactured for at least 50 years by inoculating a wort; that is, by preparing a clear liquid solution and stocking it with a small amount of seed yeast. Such worts include substances to nourish the yeast cells, and are called yeast nutrient solutions. * * * The field for investigation and improvement has been the composition of the nutrient solution, and the character of the process employed during the period of growth." (8 F. (2d) p. 187)

In the manufacture of bakers' yeast, the composition of the nutrient solution and the chemical and procedural control imposed during the propagating period affect both the quality and amount of the product obtained, and these factors of worth and cost of the product determine the utility and value of any given process.

The First Patent and Decisions on It

Claim 1, for example, of patent -103 defines the new process thereby covered. It reads:

> "The process of manufacturing yeast which comprises preparing a yeast nutrient solution and propagating yeast therein with aeration, said yeast nutrient solution containing essentially sugar material and yeast nourishing inorganic salts from which components are liberated which tend increasingly to acidify the nutrient solution during propagation, and during the period of propagation neutralizing the deleterious excess of such acidity." (R. II, 3; off'd R. I, 50).

It is to be noted that the process thus claimed comprises (a) specified composition of nutrient solution, and (b) specified chemical control. These factors are specified in combination.

In the first Maryland litigation, this patent was held valid over the prior art, and infringed. On appeal, the Court of Appeals for the Fourth Circuit made the same holding. The case was referred to a Special Master for accounting and his report on the broad, valid scope of the patent (infringement) was confirmed by the trial court prior to defendant's settlement in which appeal was waived.

In the present case, the District Court likewise held the patent valid over the prior art. He agreed in part and disagreed in part with Judge Soper as to the patent's scope (infringement). On appeal, the Circuit Court of Appeals below held the patent invalid over the prior art but did not pass on infringement*.

Thus, the two trial courts and the Circuit Court of Appeals for the Fourth Circuit have found the patent valid, while the Circuit Court of Appeals below has found it invalid.

---

* There is a partial conflict between the two trial courts with respect to infringement, but that issue is not now on review.

The Second Patent and Decisions on It

Claim 10, for example, of patent –105 defines the new process thereby covered. It reads:

> "A process of propagating yeast with a relatively low yield of alcohol which comprises, preparing a wort containing all essential yeast nutrients in solution, initiating propagation of yeast in a highly diulted portion of said wort, aerating the diluted portion, and substantially continuously adding during the period of propagation, the wort of higher concentration at a rate such that the concentration of the dilute wort remains substantially constant, whereby substantially all of the alcohol which may be formed is assimilated." (R. II, 7; off'd R. I. 50)

It is to be noted that the process of this claim comprises a specified plurality of procedural steps in prescribed sequence and in combination.

In the second Maryland litigation, the District Court held the disclosure adequate and the patent valid over the prior art, and infringed. Defendant settled without appeal.

In the present case the District Court held the patent invalid only on the ground of insufficient disclosure. On appeal, the Circuit Court below held the patent invalid over the prior art (a ground not mentioned by the trial court) and also on the ground of indefiniteness.

The Third Patent and Decisions on It

Claim 13, for example, of patent –106 defines the new process thereby covered. It reads:

> "A process of propagating yeast with a relatively low yield of alcohol which comprises initiating propagation of yeast in a dilute nutrient solution comprising essentially sugar material and yeast nourishing inorganic salts, from which components are liberated

> which tend increasingly to acidify the nutrient solution during propagation, aerating the solution, during the period of propagation adding thereto substantially continuously sugar material and yeast nourishing inorganic salts, at a rate such that the concentration of the solution in which the yeast is propagating is maintained substantially constant, and during the period of propagation neutralizing a substantial portion of such acidity by the addition of an innocuous antacid substance." (R. II, 10; off'd R. I, 50)

It will be noted that the process thus claimed comprises (a) specified composition of nutrient solution, (b) specified chemical control during propagation, and (c) specified steps in prescribed sequence, all in combination. Actually, this patent claims a unitary process in which the factors of the –103 process and of the –105 process are integrally combined.

In the second Maryland litigation, the District Court held the patent valid over the prior art and infringed. As to this patent also defendant settled without appeal.

In the present case, the District Court held it invalid on the sole ground that having held patent –105 invalid "its combination with a valid patent adds nothing to the art". (R. I, 634) The Circuit Court of Appeals below likewise held it invalid on the sole ground that

> "combining the processes of invalid process patents [–103 and –105] cannot result in validity". (R. I, 684)

Respondent's Position

It is the position of respondent that earlier patents and publications made disclosures which anticipated the claimed subjects matter of the three patents or which approxmated them so closely as to exclude the exercise of patentable invention in originating them.

As to patent –103, the Circuit Court of Appeals below adopted the latter defense premised on four items of the prior art, i.e., an abstract in English of an article in Ger-

man, dated 1908 by Henneberg (R. II, 158); a corresponding article derived from the German publication but published in English in the magazine "Pure Products", May 1908 (R. II, 162); 3 pages from a 200 page book in German published in Vienna in 1890 by Wilfert (R. II, 171); and a Swiss patent of 1913 to Pollak (R. II, 151).

As to patent –105, the same Court sustained the defense premised on two items of the prior art, i.e., a German patent of 1879 to Rainer (R. II, 135) and an abstract in English published in 1903 in the Journal of the Society of Chemical Industry (R. II, 157) of an article published in Germany by Iwanowski. All of these items of prior art were offered in one book at R. I, 160.

As to patent –106, the same Court sustained the defense that the inventor's simultaneously filed and issued patents –103 and –105 constituted prior art and that the integration of the respective processes of the earlier numbered* patents into a unitary process possessing more than the additive advantages of each was not validly patentable.

Petitioner's Position

It is petitioner's position, *contra,* that no patent or publication of the prior art makes a self-contained disclosure of the process defined in any claim in issue of the patents; that prior piecemeal and nebulous disclosures of isolated steps may not tenably be assembled, *post* the patented inventions, to depict what was obvious to the art *ante,* save under other convincing indications of obviousness not shown in the presen record; and that the practical commercial results accomplished by the pat-

* Actually the three patents issued on the same day (March 20, 1923), on applications filed in the United States on the same day under the provisions of the Act of March 3, 1921, 41 Stat. L. 1313 (the so-called "Nolan Act"), and correspond to separate applications filed abroad in the Spring of 1915.

ented processes stamp the subjects matter as derived from the exercise of patentable invention.

The practical commercial results referred to are a superior yeast product of improved baking strength, keeping quality and uniformity, and improved processes of greatly augmented yields per unit of raw materials, of great savings in the cost of raw materials, of savings in time of production, of savings in labor cost, of enhancement of plant capacities, of savings in shipping charges, all of which have been reflected in benefit to the industry and to the consuming public. These recited advantages are summarized in the opinions of Judge Soper, 8 F. (2d) p. 198; 38 F. (2d) p. 323, and 38 F. (2d) p. 337. They are not commented on in either opinion of the Courts below.

The Issues

The primary issue before this Court, therefore, is whether the patented inventions as defined by the claims in controversy are to be judicially deemed resultant from the exercise of patentable invention, on the one hand, or from the routine skill of the ordinary worker in the art, on the other hand.

As to patent -105, there is a secondary issue of sufficiency of disclosure to comply with the statutory requirements. On this it is respondent's position, sustained below, that the patent insufficiently teaches the rate of feeding the concentrated nutrient solution into the dilute nutrient solution during the propagating period. It is petitioner's position that the instruction of the patent is adequate in this regard and in full compliance with the statutory requirements. On this secondary issue the parties are in conflict more on the applicable law than on the facts.

As to patent -106, there is also the issue as to whether it is good law to use an inventor's copending applica-

tions to prevent his obtaining valid combination claims to a unitary process comprising an integration of his own separte inventions.

SPECIFICATION OF ERRORS

The error urged is that the Circuit Court of Appeals for the Third Circuit erred in holding the issue claims of the patents invalid. More particularly, error is urged in the holding that there was no exercise of patentable invention over the prior art in devising the subjects matter of the patents in suit, in the holding that the disclosure of patent –105 is insufficient to comply with the statutory requirements; and in the holding that patent –106 is invalid "since combining the processes of invalid process patents cannot result in validity".

SUMMARY OF ARGUMENT

1. Patents disclosing and claiming subject matter which is new and which has made a vital impress on its related commercial industry should be sustained.

(a) The inventions of the present patents have revolutionized the yeast manufacturing industry.

2. Patents which claim processes comprising a plurality of steps in prescribed sequence in prescribed combination and cooperating to a new or better or more economical result should not be invalidated by mere proof that the several steps separately or in different sequence or in different combination operating to a different result were old prior to the inventions of the patentee; especially when as here the references are of foreign origin and are vague, ambiguous and incomplete.

(a) The present patents contain claims for processes comprising specified steps and sequence of steps, in combination.

(b) No item of the prior art singly shows any process claimed herein. Such items were not singly nor collectively responsible for the industrial advance made by Haydueck.*

(c) Under the statutes, the patents in suit are valid.

* In view of the favorable decisions in the Maryland litigation, and the refusal of the District Court below to find any anticipatory disclosures in the prior art, and the discussions of only certain items of the prior art in the opinion of the Circuit Court of Appeals below, we shall in this main brief confine our attention to those references only which are mentioned in the latter opinion. It may be fairly assumed that the non-acceptance heretofore by all the Courts of any defense based on other pleaded references is sufficient confirmation of the presumption that the validity of the patents in suit is not adversely affected by such other references. If respondent's brief asserts otherwise, we shall treat the matter in a reply brief.

ARGUMENT

The Court has well stated:

> "In administering the patent law the court first looks into the art to find what the real merit of the alleged discovery or invention is and whether it has advanced the art substantially. If it has done so, then the court is liberal in its construction of the patent to secure to the inventor the reward he deserves."

Eibel Process Company v. *Minnesota & Ontario Paper Co.*, 261 U. S. 45, 63.

The Patented Inventions Have Revolutionized the Art

The record herein establishes that the patented inventions have revolutionized the art of yeast manufacture. Petitioner is the successor to the Fleischmann Company and is the largest manufacturer of bakers' yeast in the United States. The business has continued for more than seventy years. The commercial history of yeast manufacture in the United States for this period is fully reflected by the petitioner's operations as testified to in the Maryland litigations and in the present case. The evidence was not disputed in either case. It was briefly outlined in the opinion of Judge Soper, 8 F. (2d) p. 188), and was substantiated in the present case by the witnesses Lutz (R. I, 98-103) and Kaltenbach (R. I, 331-2). Judge Soper described the history as follows:

> **O. P. Process**—"In 1904, and for a long time prior thereto, the Fleischmann Company was using the so-called old process (O. P.) in which the raw materials for the nutrient solution consisted entirely of cereals, to wit, corn, rye, and barley malt. The average yield of yeast amounted to 12 per cent. of the raw material, and at the same time there was produced about 7 gallons of alcohol for each 100 pounds of material."

N. P. Process—"About 1911 a new process (N. P.) was introduced. In it, corn, corn malt, barley, malt, and malt sprouts were used. The most important change was the introduction of a process of aeration in which air was forced through the wort for the purpose of furnishing oxygen and thereby stimulating the multiplication of the yeast. The nutrient for the yeast was still obtained from cereal sources—sugar from the corn, and nitrogen from organic material, such as malt sprouts. From the new process, there were obtained average yeast yields of 28 per cent. of the raw material, and a certain amount of alcohol."*

G. B. Process—"In 1913, the Fleischmann Company modified its manufacture by adopting the German Bakers' (G. B.) process. This was practically the same as the N. P., except that corn malt was eliminated, and there was stronger aeration. Sugar and nitrogen were still obtained from organic sources. The average yeast yield was increased to about 35 per cent., and the alcohol yield was about 2½ gallons per 100 pounds of material."

G. B. M. Process—"In 1917, the G. B. process was superseded by what was called the German Bakers' Molasses (G. B. M.) process. This was during the war period, and it was necessary to conserve grain. Molasses was substituted for corn. With this process an average yeast yield of 33 per cent. was obtained, and about the same alcohol yield as before. With the exception of the substitution of molasses for corn, the process in other respects was the same as the G. B. process. It is noteworthy that this process represented the best method known to the Fleischmann Company in the manufacture of yeast from molasses, and, secondly, that although the method was cheaper, the yeast product was of a somewhat inferior quality. On the latter account, the company reverted to the G. B. method as soon as the government restrictions on grain were removed in 1918, notwithstanding an increased cost of production."

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* Luce—2½ gallons (R. I, 100).

A. M. Process*—"This was the situation until 1919, when the Fleischmann Company, having acquired by assignment the inventions covered by the patents in suit, began the manufacture of yeast under the processes therein disclosed. The change is described as revolutionary. The use of cereals was abandoned entirely, and the wort was made from beet molasses, with the addition of ammonium phosphate and of aqua ammonia, added fractionally during the process. The solution therefore contained nutriment from both organic and inorganic sources. The yield of yeast was increased to 65 per cent. of the materials, and it was no longer necessary to make alcohol along with the yeast." (8 F. (2d) p. 188)

All of the above processes were of the "straight-set" type wherein the ingredients were all placed together with the seed yeast in the propagating vat at substantially the commencement of the propagation and wherein the nutrient content of the solution progressively decreased during the period of propagation (R. I, 102; 38 F. (2d) pp. 330-331).

In 1923 plaintiff adopted the "Zulauf" or "regulated feeding" process employing molasses and inorganic ammonium salts with neutralization, in which the propagation was initiated in a dilute portion of the nutrient solution and more concentrated reserve solution was continuously added during propagation at a rate to maintain the nutrient content of the solution substantially constant at an optimum during the propagating period. The "Zulauf" process is generically shown and claimed in patent –105. The perfected process using also inorganic ammonium salts and neutralization is shown (and specifically claimed) in patent –106. Both constitute radical departures from prior commercial practice. The use of the process resulted in the yield being increased to 80% on the raw materials with no undesired alcohol production (R. I, 103-6, 127-8). In some of its plants petitioner also used the process with grain worts as spe-

* This is shown and broadly claimed by Hayduck –103.

cifically shown in patent –105 (R. I, 104). With respect to the "Zulauf" process of patents –105 and –106 Judge Soper, in the second Maryland case, said:

> **Zulauf Process**—"The important feature of the process disclosed by this patent relates to the method in which the mash or wort is introduced into the propagating vat. A feeding process, referred to in the testimony as the Zulauf feed, is prescribed, whereby a comparatively small part of the nutrient solution is diluted, placed in the vat and seeded with yeast, and, after it has begun to grow and propagate, the remainder of the wort is fed in gradually to supply its increasing needs. As we shall see, this change has been accompanied by a great increase in the yield of yeast from raw material in the modern yeast factory." (38 F. (2d) p. 331)
>
> "* * * The present method of the plaintiff is to combine the process of patent –103 with that of patent –105 [which combination is the process of patent –106] and the result has been a substantial increase in yield, so that there is now obtained an average of 80% of yeast from the raw material." (*id.* p. 337, bracketed insert ours.)

On the important matter of commercial history, the opinion of the Circuit Court of Appeals below is so incomplete as to be inaccurate. It also mistates the prior holding of Judge Soper. It says:

> "The art of manufacturing yeast is a very old one. * * * Originally nutrient solutions were prepared by souring cereals with water in souring tanks, such cereals including corn, rye, barley and malt, all of which are organic materials as distinguished from inorganic materials. * * * When the souring process had continued sufficiently, the nutrient solution or wort thus attained was drained off and put with the seed yeast into the fermenting tank where the actual propagation of yeast from the seed yeast took place. In later years, particularly during the course of the World War which required conservation of grains, molasses was used as the source of sugar in the making of nutrient solutions in lieu of cereals.

> In 1919 inorganic salts capable of nourishing yeast were used in place of organic nitrogenous materials. This forward step in the art properly may be described as revolutionary. Judge Soper in Fleischmann Yeast Co. v. Federal Yeast Corporation so described it. With comparatively immaterial changes this method of producing nutrient solutions is substantially that used today." (R. I, 671-72)

Judge Biggs compressed three errors of fact into the language just quoted namely:

First, his statement of the 1919 improvement is incomplete to the extent that it becomes mis-descriptive. The improved process as adopted comprised, in combination, the factor of using yeast nourishing inorganic salts and the factor of neutralizing the *deleterious excess* of acidity resultant from such salts during the period of propagation. That is, the 1919 commercial process was the process in its entirety of the –103 patent, and was not the lesser step which Judge Biggs stated it to be.

Second, Judge Biggs then says that the lesser steps (not Hayduck's patented invention) "properly may be described as revolutionary" and that Judge Soper "so described it". This latter is not true. It was in fact the *complete* invention of the –103 patent which constituted the 1919 "forward step" described as "revolutionary" by Judge Soper. The latter's opinion is very specific on the point. He said:

> "Specifically it (patent –103) relates to a process for the production of bakers' yeast by propagation in a solution containing sugar materials and yeast-nourishing inorganic salts. * * * **This, however, is but a part of the process.** The specification of the patent shows that there takes place in such solutions a considerable increase of acid content, for the most part of an inorganic nature. * * * The accumulation of acid products or free inorganic acids influences the yeast unfavorably, if permitted to act unrestrainedly

upon the yeast for any considerable length of time. Hence the inventor, in order to prevent the harmful effect of the acid upon the yeast, teaches a special means of control by the addition of an antacid substance. * * * **The advantage of the process is that by the supply of nutriment through the addition of inorganic salts and by the neutralization at the same time of the deleterious effect of the discarded acid radicals of the inorganic salts, unprecedented yeast yields may be obtained**" (8 F. (2d) p. 189).*

And, describing this 1919 commercial change, Judge Soper said:

> "This was the situation until 1919, when the Fleischmann Company, having acquired by assignment the inventions covered by the patents in suit, *began the manufacture of yeast under the processes therein disclosed.* The change is described as revolutionary" (8 F. (2d) p. 188).

Thus it was the adoption of the complete –103 Hayduck process which constituted the 1919 change in commercial practice and which Judge Soper endorsed as "revolutionary." Both contrary statements of Judge Biggs are in plain error.

THIRD, the Court below made no mention of the notable commercial change introduced in 1923 and used today, which comprised the adoption of the full inventions disclosed and claimed in Hayduck's patents –105 and –106, and which Judge Soper correctly found was "accompanied by a great increase in the yield of yeast from raw materials in the modern yeast factory", and **"these yields are unprecedented in the yeast industry"** (38 F. (2d) pp. 331 and 337).

The Court apparently failed to take into consideration the fact that plaintiff had up to the date of trial, October 1935, already made over two billion pounds of yeast under

* Emphasis ours throughout.

patent –103 and that the patented invention had been paid the tribute of appropriation by the Federal Yeast Corporation (defendant in the Maryland litigations), and by respondent.*

That the introduction of the regulated feeding process was accompanied by a large increase in yield was admitted by respondent's witness Rautenstrauch (R. I, 244), who said that for over fifty years the commercial art had been using the straight-set mash, (R. I, 217), despite its low yields. The Court below apparently failed to credit patents –105 and –106 with these admissions or with the facts that the defendant Federal had likewise paid tribute to these patents by appropriating their inventions and that petitioner had up to the time of trial made over one billion seven hundred million pounds of yeast thereunder (R. I, 105).

It is established that the invention claimed in the patents revolutionized the commercial art. Patent –103 jumped the yeast yields from 35% for the best prior practice, to 65%, and other advantages of superior quality, increased plant capacity, and the savings indicated above also accompanied the change (R. I, 102-105). Likewise, the broad Zulauf invention of patent –105 and the specific climaxing invention of patent –106 when adopted in 1923 further jumped the yeast yield to 80% on the basis of raw materials with still further improvement in quality (R. I, 103-105).

The patented inventions have, therefore, fully met what this Court has defined as the first test to apply, and are entitled to receive the consideration which this Court holds shall follow, as set forth in the case of *Eibel Process Company* v. *Minnesota & Ontario Paper Co.*, 261 U. S. 45, 63, quoted *supra* p. 11.

Some years earlier, Judge Ward expressed the same principle in words which likewise crystallize sound fundamentals of the American patent law.

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* Respondent conceded at the trial that it had infringed patent –103, if valid (R. I, 627).

"The keynote of all the decisions is the extent of the benefit conferred upon mankind. Where the court has determined that this benefit is valuable and extensive it will, we think, be difficult to find a well considered case where the patent has been overthrown on the ground of nonpatentability."

O'Rourke Engineering Const. Co. v. *McMullen et al.*, 160 Fed. 933, 939, (C. C. A. 2).

The Prior Commercial Art Is Non-Anticipatory

This prior commercial history makes it clear that the patented processes were new, and validly patentable.

(a) Until after the effective dates of the patents the commercial practice always comprised using organic materials (such as corn, rye, corn malt and barley malt) as the exclusive source of nutrients to carry on the yeast propagation.

(b) The commercial practice also was always "straight set", i.e., the entire nutrient supply was incorporated in the vat at the start so that during the period of propagation the nutrient concentration in the wort was gradually and progressively attenuated. The nutrient concentration was measured on a "Balling" scale; high Balling indicating high concentration, and low Balling low concentration. Attentuation of nutrients during propagation was indicated by gradually lowered Balling of the wort during operation. This attenuation resulted from consumption of the nutrients by the yeast, partly in the making of new yeast and partly in the making of alcohol. The yeast yield and the alcohol yield represented diverse end products. The nutrients consumed in making yeast were not available in making alcohol, and conversely the nutrients consumed in making alcohol were not available in making yeast.

During all of the time yeast was the more valuable product so there was always a profit incentive to discover im-

proved processes whereby a greater percentage of the raw materials could be utilized in making yeast and a lesser percentage in making alcohol without, of course, entailing any sacrifice in the quality of the yeast or entailing any other off-setting loss in efficiency and economy (R. I, 331-32).

(c) During most of this time the art knew that high concentrations of sugar nutrient in the wort tended toward sacrificing yeast yield in favor of greater alcohol yield, but did nothing about it because other factors of cost and efficiency were practically involved; and the commercial yeast manufacturing practice was always to employ worts containing relatively high concentration of sugar at the commencement of the propagation and to allow the nutrient concentration to be progressively attenuated during the period of propagation.

(d) In the light of the above it is most interesting to note the commercial art's efforts toward improvement up to the time of adopting the invention of the first patent in suit. The progress may be tabulated as follows (cf. R. I, 98 *et seq.*):

Date	Process	Yeast Yield in % of Raw Materials	Alcohol Yield in Gallons Per 100 lbs. Raw Material
To 1911	O. P.	12	7
1911-1913	N. P.	28	2½
1913-1917	G. B.	35	2½
1917-1918	G. B. M.*	33	2½
1918-1919	G. B.	35	2½

The raw materials in all of these processes prior to the effective dates of the patents, were grains or mixtures of grains. In other words, the nutrients were all from organic sources, without either inorganic ammonium salts or neutralization of deleterious acidity therefrom.

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* Molasses was used for a short time in the G. B. M. process, but not with much success, and petitioner resumed the G. B. process (cf. *supra*, p. 12).

(e) In 1919 plaintiff changed its manufacturing methods to utilize the invention covered by patent –103. The new process jumped the yeast yield to 65%.

(f) In testing patentability of inventions, at least in an established industry alert toward improvements, the prior commercial art is a most reliable guide not only because it affords the best comparison to judge the quality of the commercial advance effected by the new invention to be judged, but also because it constitutes in itself a realistic appraisal of the prior "paper" art.

It is accordingly worth noting that in all the litigation to date upon the patents in suit, the full novelty of the Hayduck inventions has been recognized so far as concerns prior yeast making practices actually used by the industry.

The Patents in Suit Cover Novel Combinations

Patents which claim processes comprising a plurality of steps in prescribed sequence, in prescribed combination and cooperating to a new or better or more economical result should not be invalidated by mere proof that the several steps separately or in different sequence, or in different combination, operating to a different result, were old prior to the inventions of the patentee.

This Court and others have expressed and accepted the foregoing rule, as follows:

> "A combination is a union of elements, which may be partly old and partly new, or wholly old or wholly new. But whether new or old, the combination is a means—an invention—distinct from them."
>
> *Leeds and Catlin Company* v. *Victor Talking Machine Company*, 213 U. S. 301, 318.

> "Common justice forbids such a defense, as it would work a virtual repeal of so much of the Patent Act as gives to inventors the right to a patent con-

sisting of old elements, where the combination itself is new and produces a new and useful result. New elements in such a patent are not required, and if such a defense were allowed, not one patent of the kind in a thousand of modern date could be held valid. Nor is such a defense consistent with the regulations enacted by Congress in respect to the procedure in litigations in respect to patent-rights."

Parks v. *Booth*, 102 U. S. 96, 104.

"The principles of law applicable are elementary and are well stated, with citation of the supporting authorities, in 20 R. C. L. pp. 1125, 1126, as follows:

'A combination is a composition of elements, some of which may be old and others new, or all old or all new. It is, however, the combination that is the invention, and is as much a unit in contemplation of law as a single or noncomposite instrument. The authorities establish the following propositions respecting the patentability of devices or processes of this character: (1) That a combination is patentable if it produces new and useful results, though all its constituents were well known and in common use before it was made, provided the results are a product of the combination, and not a mere aggregate of several results, each the product of one of the combined elements. (2) If it produces a different force, effect, or result in the combined forces or processes from that given by their separate parts, and a new result is given by their union. (3) If it either forms a new machine of distinct character or formation, or produces a result which is not the mere aggregate of separate contributions, but is due to the joint and cooperating action of all the elements. (4) When the several elements of which it is composed produce by their joint action either a new and useful result, or an old result in a cheaper or otherwise more advantageous way'."

United States Industrial Chemical Co. v. *Theroz Co.*, 25 F. (2d) 387, 391-2, (4th C.C.A., Cert. Den. 278 U. S. 608).

See also:

Permutit Co. v. *Harvey,* 279 Fed. 713, 718-720, (C. C. A. 2).

For convenience of arrangement we shall now treat the three patents in suit seriatim, and, as to each, shall discuss (a) the claims, and (b) the prior art and Record; including comments on the opinions rendered in the Courts in this and the Maryland litigations

As to Patent –103

The Disclosure

The claims in suit (1-4 and 7-15 both incl.*) are drawn to processes comprising a particular combination of prescribed steps in a prescribed sequence. They involve factors of chemical composition, control, and time.

Claim 1, for example, of patent –103 recites:

> "The process of manufacturing yeast which comprises preparing a yeast nutrient solution and propagating yeast therein with aeration,
>
> said yeast nutrient solution containing essentially
>
> sugar material
>
> and yeast nourishing inorganic salts from which components are liberated which tend increasingly to acidify the nutrient solution during propagation,
>
> and during the period of propagation neutralizing the deleterious excess of such acidity" (R. II, 3).

It is self evident that the claim does not cover all uses of sugar material and inorganic salts. It does not cover

* All of these excepts Claims 9, 10 and 11 were in suit and held valid and infringed in the first Maryland litigation and in the accounting thereon (8 F. (2d) 186; 38 F. (2d) 314).

complete neutralization of all acids in all processes involving yeast, irrespective of the cause or amount of such acidity, or irrespective of the time or extent of such neutralization.

It covers, rather, the integral coordination of propagating yeast with aeration in a prepared solution containing essentially sugar material and yeast nourishing inorganic salts from which results an increasing acidification tending to become deleterious, and neutralizing the *deleterious excess* of such acidity in the solution while the yeast propagation is being conducted.

Other claims are of graduated scope including further limiting definitions. For example, Claims 2 recites that the neutralizing of the *deleterious excess* acidity shall be "by the addition of an innocuous antacid substance", while Claim 4 still further recites that the latter is "adapted to supply yeast assimilable nitrogen to the yeast". Others of the claims specify that the inorganic salts shall include ammonium sulphate (Claim 9); and that the sugar material shall be molasses (Claims 12, 13, 14). Claim 15 covers the article of manufacture comprising the yeast product made by the defined process.

The patent discloses molasses as "a suitable source of sugar for the yeast production" (R. II, 1, ls. 104-106); ammonium sulfate and phosphate as suitable "inorganic yeast nutrient salts" "in such aggregate quantities and in such proportions as are requisite for supplying * * * the elements for the production of yeast" (R. II, 2, ls. 100-110); calcium carbonate or "other basic or antacid substances such as antacid substances containing or supplying nitrogen can be employed for the neutralization" (R. II, 1, ls. 66-70); and directs one how to calculate the amount of neutralizing agent necessary to neutralize "whatever *detrimental excess* of free acid tends to develop in the nutrient medium during the yeast growth", and when and how it may be added (R. II, 1, ls. 96 *et seq.*; 2, ls. 10-14).

The sufficiency of disclosure of the patent has not been disputed. The superiority of the product, the variety and extent of the savings accompanying the commercial adoption of the process, before pointed out, have likewise not been disputed. There remains then to consider the question of its novelty and patentability over the prior art.

The Prior "Paper" Art Is Non-Anticipatory

The record (R. I, 44) lists the prior publications and patents first relied on by respondent against patent –103. The trial Court held them all non-anticipatory. The Circuit Court of Appeals below reached the contrary holding on the basis of four items. Of these four, three had already been before the courts in the Maryland litigation and held non-anticipatory. We shall review all four in detail.

1. Henneberg Abstract 1908 (R. II, 158)

This report purports to be a summary of a twenty-six page foreign language article originally published by Henneberg in Wochenschrift für Brauerei (1908). The original article and a companion article of 1907 are fully discussed by Judge Soper (8 F. (2d) pp. 191-195), who found them both non-anticipatory and very similar in disclosure.

Henneberg was reporting on scientific data and conclusions with respect to laboratory experiments conducted on a minute test tube scale and under very special conditions. The abstract reports the conclusions but not the data and conveys less information and hence is less relevant than the original.

Henneberg said that:

> "* * * rye or wheat meal, egg albumen, peptone, lecithin and inorganic ammonium salts" * * * are "(1) non-poisonous to yeast in pure *distilled* water, (2) or less poisonous in *distilled* water in presence of sucrose, (3) **Non-poisonous in supply water [that is,**

ordinary water such as is always used in commercial operation], (4) non-poisonous in sucrose solutions, if calcium salts, carbonates or bases are present in small amounts or other salts (such as acid potassium phosphate, magnesium sulphate, sodium sulphide, sodium formate or potassium sulphate) in higher concentrations, and (5) of great nutritive value in presence of the substances mentioned under (4)." (R. II, 158)

These statements relate to both the organic and inorganic nitrogenous materials listed.

Respondent's witness Rautenstrauch was asked on direct examination as to conclusion (4) above (R. I, 174), as follows:

"What is meant by sucrose solution?

A. A solution containing sugar, wherever it comes from, molasses or what it may come from.

Q. 71. Why do you understand that these 'inorganic ammonium salts' are not poisonous in these sugar solutions?

A. It just so happens that in the presence of the sugar, affinity of the yeast for the sugar will make the salts inoperative, whereas if there is no sugar present the salts will have a deleterious effect on the yeast cells."

In the language quoted respondent's expert witness thus explains Henneberg's conclusion (4) as meaning that there is no advantage or utility in the addition of inorganic ammonium salts to yeast nutrient solutions, because such yeast solutions contain sugar, and in the presence of sugar the salts are inoperative. Undoubtedly Henneberg's statements are very unclear, but if they mean what respondent's expert says in the language quoted, then Henneberg utterly failed to foreshadow the invention made by Hayduck years later.

On cross examination the witness Rautenstrauch accepted Henneberg's conclusion (3), namely, that the

nitrogenous substances tested (i.e., both organic and inorganic) are non-poisonous in ordinary supply water (as distinguished from distilled water) (R. I, 213). From this expressed conclusion of Henneberg it would follow that if either inorganic ammonium salts or an organic nitrogen source were added to a yeast nutrient solution in commercial manufacture, it would entail no problem of toxicity because such yeast nutrient solutions are always made up of ordinary supply water (R. I, 511).

Thus, the net result of Henneberg's fourth conclusion as interpreted by respondent's expert, and of his third conclusion, as accepted by respondent's expert, would be that the Henneberg reference pointed away from the Hayduck–103 process because first, the latter provides a "yeast nutrient solution containing essentially sugar material" and second, it uses ordinary water (with of course yeast nourishing inorganic ammonium salts and the step of neutralizing the *deleterious excess* of released inorganic acidity from such salts); whereas the Henneberg article would have taught that inorganic ammonium salts are not poisonous in the solution containing sugar if ordinary water is used.

Petitioner's witness Lamb was asked what the significance of Henneberg's third conclusion would be to a yeast manufacturer, and replied:

> "The inference certainly would be that the nitrogenous substances listed in the preceding paragraph would not be poisonous to yeast in solutions containing sugar in ordinary tap water or commercial water. . . . So whether a yeast manufacturer could draw important conclusions from these experiments with regard to his own operations I very much doubt." (R. I, 403)

The opinion of the Circuit Court of Appeals below makes no mention of the foregoing testimony. It quotes only a later portion of the Henneberg abstract divorced from the context, reading:

> "Under ordinary conditions, these nitrogenous substances form excellent nutrient materials for yeast, their injurious action only appearing in the absence of certain solutions which are more especially compounds capable of neutralizing acids. * * *" (R. II, 158)

In quoting this paragraph the Court apparently did not realize that, as petitioner's witness Lamb pointed out and counsel for respondent agreed (R. I, 512), the only condition under which Henneberg found any of the nitrogenous substances (organic or inorganic) tested by him to be harmful is in distilled water which is not an "ordinary condition", and which condition is of no practical interest whatever in any commercial yeast manufacturing process, because tap water is used.

Suffice it to say, that Henneberg had no conception of the employment of the combination of ammonium salts as a substantial source of inorganic nitrogen together with controlled neutralization of attendant deleterious acidity in a process of yeast manufacture. Indeed, Henneberg's work was all experimental and in the only instance of nutrients where he simulated commercial conditions, namely, *when he used tap water, he omitted any neutralizing or antacid agent and found it unimportant* [see conclusion (3)].

In other words, the Henneberg article would have misled the commercial yeast manufacturer to believe that whether he employed inorganic ammonium salts or an organic nitrogen source no problem of toxicity would be encountered.

Of course Hayduck discovered that such a problem would be encountered and discovered the solution for the problem, and in solving it "went against the combined opinion and teaching of his time" (R. I, 513).

In such circumstances to say that Henneberg's disclosure invalidates the Hayduck patent is like saying that one who says that smallpox is not contagious, has anticipated the discovery of another who finds the con-

ditions of its being contagious and also finds a vaccine to prevent its spread.

Moreover the opinion of the Circuit Court of Appeals below ignores entirely the fact that Henneberg a year later in 1909 wrote a text book (Henneberg's Praktikum), which, as distinguished from his reports on experiments, contained a section for the practical guidance of the commercial yeast manufacturing art. In this connection, as pointed out by petitioner's expert witness Lamb (R. I, 434-34) and by the opinion of Judge Soper (8 F. (2d) p. 196), there is not even a faint or remote suggestion of the use of inorganic ammonium salts with neutralization of deleterious acidity. Cereal material such as malt sprouts were relied on as the source of nitrogen, and the only mention of ammonium phosphate was as an alternative to superphosphate as source of phosphorus.

It is submitted (and Judge Soper found to the same effect, 8 F. (2d) p. 196), that this is the strongest proof that Henneberg's 1908 article reporting on laboratory experiments did not teach even its author (and much less therefore could it teach others) the combination of steps later invented by Hayduck and constituting the claimed process of his patent -103. Seldom does the court in a patent case have before it for appraisal an item of the prior paper art, where its own author himself later shows its sterility as a prior disclosure. It would seem elemental that what Henneberg himself did not read out of his 1908 article cannot in sound law or common sense be judicially read out of it thirty years later.

2. Pure Products Magazine of 1908 (R. II, 162)

This is another summary of the same original Henneberg article. It also contains no details and is less informative than the original. Respondent's witness Rautenstrauch concedes that the Pure Products' article is the same as the Henneberg abstract discussed above:

> "A. * * * I should say that the disclosure in the Pure Products article was quite similar to that

which was in the condensed article. They are the same in my opinion." (R. I, 212-213)

The opinion of the Court of Appeals below, speaking of the Pure Products article, says only:

> "This article recognizes the phenomenon of the generation of free acid when yeast is used in brewing and distilling processes* and the fact that such acids may be rendered innocuous by the addition of lime salts." (R. I, 676)

For the reasons pointed out above, the Court's statement is in error if it refers, as apparently intended, to any commercial or commercially useful yeast manufacturing process. The article actually dealt only with the laboratory test tube experiments (above discussed), in distilled water. It gave no hint that in any commercial yeast wort inorganic ammonium salts could be usefully added in substantial amounts to the nutrient solution, and that, if added, they would entail any *excess* or *deleterious acidity* problem, or that if such problem occurred, how to solve it.

Judge Soper pointed out the inadequacy of the Henneberg articles and said that, if Henneberg had known what defendant there (and respondent here) asserted his articles showed, he would have told the world about it when writing his book. Judge Soper also pointed out that the defendant's expert in that case (Dr. Willcox), was Editor of the Pure Products Magazine at the time it published the Henneberg abstract and at the same time had been conducting a school for instructing yeast manufacturers and yet that the Henneberg article failed wholly to teach Dr. Willcox the invention later discovered and patented by Hayduck (8 F. (2d) p. 197).

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* Judge Soper pointed out the difference between a yeast manufacturing process and an alcoholic fermentation such as is here referred to by the Court; and noted that Heneberg's 1908 article said nothing about yeast yields (8 F. (2d) p. 195).

In the present record respondent has offered no testimony which detracts from the soundness of the prior Court's conclusions that the Hayduck patents are valid and pioneer over everything that Henneberg had done or published earlier (*J.* Soper, 8 F. (2d) pp. 191-195); 4th C. C. A. 13 F. (2d) 570; and *J.* Fake, 21 F. Supp. 46).

3. Wilfert Book of 1890. (R. II, 171)

This is a translation of three pages from a book in German published in Vienna. The book was not in evidence in the Maryland litigations. It deals exclusively with the *pre-treatment* of a nutrient solution made from grain material. It refers to adding 1% of 5 times diluted sulphuric acid to a grain mash for the purpose of converting the proteins into peptones, and notes that by such addition the mash "contains a rather large amount of sulphuric acid", which "would have a disadvantageous influence on the mother yeast which is now to be added". Accordingly it advises the addition "of so much sweet mash" (not containing acid) held at ordinary temperature that the temperature of the mixture drops to 16° R., and states:

> "In a mash in which the sulphuric acid content is diluted to that extent, the development of the yeast and the fermentation proceed in a perfectly normal way, and there is no reason to be found for removing the sulphuric acid from the liquor." (R. II, 173)

However, if the removal of the acid is desired, Wilfert says:

> "This can be done in a very simple way by adding to the mash slaked lime * * *. The lime combines with the sulphuric acid to form calcium sulphate or sypsum, which compound is only slightly soluble in water and accordingly separates from the liquid in the form of a white powder. After the addition of the lime the liquid must be left undisturbed until the lime has settled out at the bottom, after which

the liquor standing above the sediment is carefully drawn off" (*id.*).

Finally, the excerpt concludes:

> "As one can convince himself by a comparative test with two lots of the same mash, one of which was neutralized with lime whereas the other was left in the original state, the neutralization has not the slightest influence on the amount of newly-produced yeast nor its fermenting power and for these reasons the neutralization can be omitted entirely." (R. II, 174)

So far as its scientific relevance is concerned, the Wilfert excerpt teaches no more than that sulphuric acid can be used in the clarification and peptonizing pre-treatment of grain mashes, and that such mashes may then by dilution or by pre-neutralization be prepared for subsequent employment in yeast manufacture. Wilfert states that between the two methods of pre-treatment there is not the slightest difference in quantity of subsequent yeast yield.

It is difficult to imagine a more tenuous and specious basis for argument than Wilfert affords to support the defense of anticipatory disclosure against patent –103. This excerpt deals only with preparatory operations and not with yeast propagation and makes no disclosure whatever of the use of nitrogen from inorganic ammonium salts that would release deleterious acid, and likewise no disclosure of the use of aqua ammonia or other antacid to combat such deleterious acidity in yeast manufacture.

Wilfert's whole book was in the art for a quarter of a century before Hayduck's invention, and during that period no one ever gleaned from it either the factor of adding inorganic ammonium salts to a yeast nutrient solution, or the factor of neutralizing the deleterious excess of released inorganic acid during the period of yeast propagation, or the combination of these two things which constitutes the integral process of patent –103.

4. Pollak Swiss Patent of 1913 (R. II, 151)

The Circuit Court of Appeals below states:

> "It is true * * * that Pollak's process is to be employed with the end result of increasing the acid, increasing the yield of the yeast thereby, but the fact remains that Pollak did disclose a method of control of acidity by neutralizing acids by means of the 'ammonia compounds' e.g. ammonia or strongly alkaline ammonium compounds." (R. I, 678-79)

The only mention of acids and neutralization by this Pollak patent (like Wilfert) deals with pre-treatment of a wort *before* it is to be used in the yeast propagating process. Respondent's witness Rautenstrauch agreed with this:

> "Referring to the Pollack reference, that shows a *pre-treatment* of the mash materials by lactic fermentation." (R. I, 211)

Petitioner's witness Lamb likewise said:

> "It describes the preparation of one of the raw materials that is to be utilized in the manufacture of yeast *at a later stage.*" (R. I, 401)

The two witnesses agreed that Pollak's procedure was for the production of an increased amount of lactic acid in the souring mash (i.e., during the preparation as distinguished from the utilization of the nutrient solution). Lactic acid is an organic acid, and in any concentration ordinarily encountered is not deleterious to yeast propagation, being distinguished in both those respects from the deleterious acid involved in the Hayduck process. Pollak's object was to neutralize lactic acid created in the souring pre-treatment to convert it into ammonium lactate (an *organic* ammonium salt), which was assimilable as a yeast food. Pollak did not disclose the use of a nutrient solution including substantial amounts of assimilable nitrogen from *inorganic* ammonium salts which would

release harmful acid during yeast manufacture. Therefore, he did not have Hayduck's problem. He did not disclose the use of aqua ammonia or other antacid during yeast propagation to combat any acidity problem.

The most that Pollak may be said to disclose is a repetition of the very old scientific knowledge that acids may be neutralized, and his new discovery that lactic acid souring in the *pre-treatment* of a mash can be carried to greater lengths if a portion of that lactic acid is periodically converted into ammonium lactate. The former item of scientific knowledge was probably centuries old. It was a "natural law" discovered in the infancy of chemistry. The later item of knowledge was Pollak's new application of that natural law, but is utterly different from the application of that law in the process of patent –103. The Circuit Court of Appeals below refers only to Pollak's disclosure of the natural law. It does not find anything in Pollak which even hints at the employment of *inorganic* ammonium salts as yeast nutrients, nor of the neutralization of released *inorganic acid* from such salts *during yeast propagation*, which two factors in combination comprise the Hayduck process.

Pollak's object was practically the antithesis of Hayduck's. Pollak sought to make more sugar into an organic acid to form larger amounts of the organic ammonium salt, all *prior* to yeast propagation—Hayduck used the sugar plus inorganic ammonium salts to make yeast, and neutralized the deleterious excess of resulting acidity released *during* the propagation. Pollak's technical irrelevance is concisely stated by petitioner's witness Lamb (R. I, 400).

5. The Same Art Contrasted by Patent –103 Specification

Portions of the Hayduck specification contrast the state of prior knowledge with the subject of his newly-invented process.

It is the undisputed fact that in these portions of the –103 patent, quoted by the Circuit Court of Appeals below

(R. I, 673-675), and relied on by it as anticipating the patent, the patentee correctly contrasts such prior disclosures as Henneberg and Pollak with his own invention. This fact is of significance (1) because it is confirmatory of the differences, and the importance of the differences, between such prior art and the Hayduck process, and (2) because it proves that patent -103 was allowed by the Examiners in the Patent Office in the face of the same prior knowledge now presented in defense to its validity. The law is well settled that in such circumstances the presumption of validity is strengthened and the burden of proof on the defendant is accordingly increased.

The situation was concisely summarized by the Circuit Court of Appeals for the Fourth Circuit as follows:

> "In the opinion below, 8 F. (2d) 186, will be found a full, fair, and painstaking review of the evidence and of the contentions of the respective parties. It need not be here repeated. We have given careful examination to the record, and have considered the elaborate arguments, oral and printed, which have been submitted to us, and are satisfied the court below was right in holding the Hayduck patent valid. Henneberg and perhaps others of the earlier workers in the field may have come near the discovery described by Hayduck, but none of them made it. Some of them were among the most highly skilled of the world's experts in the yeast-making art. They were in immediate and almost daily touch with the practical men of the industry, as well as with those who controlled the capital employed in it. They were on the outlook for every possible improvement in its methods. If they had known of the Hayduck process, they would have made prompt use of it." (13 F. (2d) pp. 570-571)

The Specific Errors of Fact in the Opinion Below as to the Prior "Paper" Art

(a) The opinion (below) at R. I, 680, states:

> "* * * there is nothing new, nor is it claimed that there is anything new or patentable in the use of

sugar or in the use of molasses with inorganic salts, such as ammonium sulphate to create nutrient solutions for the manufacture of yeast."

The Court below failed to comprehend that merely this by itself was not even useful. It is true that others had proposed using such salts, but it is also true that such proposals had always been commercially rejected because: on the one hand, if they were added in potentially beneficial amounts, the addition *ipso facto* would cause a toxic condition to arise; and on the other hand, if such additions were made in amounts limited to avoid such development, the addition was not enough to be significantly beneficial.

It is easily understandable that the practical art refrained from entering either cul de sac.

The witness Lamb testified:

"Can you tell us whether it was known before Hayduck that inorganic ammonium salts could be used for yeast salts?

A. Ammonium salts had been used as an ingredient in culture experiments in which minute specimens of yeast were grown for scientific purposes and also in the initial stages in the preparation of seed yeast. I don't know of any extensive use of inorganic ammonium salts.

XQ. 806. Had that been proposed for use as yeast nutrients in yeast manufacture?

A. Not in significant amounts." (R. I, 509-10)

(b) The opinion below continues:

"The element of invention claimed by Hayduck consists in the production of unusually large yields of yeast by the use of a neutralizer for the acid components during the period of the propagation of the yeast." (R. I, 680)

This statement is also incomplete and thereby erroneous. The element of invention claimed by patent -103 is in the

combination of (a) adding inorganic ammonium salts to normal sugar worts in large enough amounts to be of greatly significant potential benefit, and (b) adding during propagation an antacid to offset the *deleterious excess* of released inorganic acid which would otherwise create toxicity. In other words, Hayduck added amounts of great *potential* benefit and added something else (i.e., controlled amounts of antacid) to make that full potential benefit an *actual* benefit. Neither factor had any utility without the other. They had never before been used in combination, and Hayduck's invention combining them resulted in what Judge Biggs below calls "unusually large yields of yeast" and what Judge Soper calls "revolutionizing the art".

(c) The opinion below concludes:

> "At the most, in the patent *sub judice* Hayduck has applied the prior art to the propagation of yeast when acidity was deleterious and unwanted. At the least, he has not done as much as this since Wilfert disclosed the principle upon which Hayduck rests his disclosure in respect to the propagation of yeast." (R. I, 680)

We submit that the Court below again erred. At both the most and the least, Hayduck originated a process comprising a new combination of (a) adding inorganic ammonium salts in amounts of great potential benefit, and (b) adding antacid to neutralize the deleterious excess of released inorganic acid to make the potential benefit an actual one. Henneberg did not disclose that invention. On the contrary, Henneberg stated that in the only wort which would be used commercially (made with ordinary water) no such acidity problem would arise. He was wrong, but no one knew he was wrong until Hayduck discovered that the problem did arise and invented his process which deliberately encountered and controlled it. Henneberg's later practical text book proves that the same author's 1908 experimental report did not teach even Henneberg what

the Court below now holds it should have made obvious to everyone else!

As for Wilfert, the only "principle" disclosed is that in the *preparatory* clarification treatment of a wort by sulphuric acid, later dilution or later fixation and careful removal of the acid radicals was desirable *prior* to adding seed yeast. Wilfert says:

> "As one can convince himself by a comparative test with two lots of the same mash, one of which was neutralized with lime whereas the other was left in the original state, *the neutralization has not the slightest influence on the amount of newly-produced yeast* nor its fermenting power, and for these reasons the neutralization can be omitted entirely." (R. II, 174)

Contrasting this with Hayduck's discovery that the yeast yield could be *doubled*, how can it fairly be said that the principle used by Wilfert was the same as the principle used by Hayduck? Wilfert added no inorganic ammonium salts. In the instance where he formed calcium sulphate *in situ*, he was careful physically to remove it. During propagation there was no release of inorganic acidity nor neutralization of the deleterious excess thereof.

In the face of Wilfert's quoted statement, it would seem to do violence to common sense and to sound law to hold such a reference to invalidate Hayduck's patent which showed twenty-six years later how—by using different materials and exercising different control at a different time—the commercial art could be revolutionized. Certainly such a holding is hardly consonant with the principle of the patent statutes to reward one who "promotes the progress of the useful arts".

We submit that the novelty of the Hayduck process is established. None of the references referred to by Judge Biggs contains any disclosure of the integral process covered by patent –103.

The Specific Errors of Law in the Definition of Patentability Adopted in the Opinion Below

The adverse conclusions as to validity in the opinion below may be explainable on misapprehensions of the law, and we believe the opinion clearly indicates that such was indeed the case.

The Court states:

> "We think that the test of invention to be applied to the patent *sub judice* may be summed up as follows: patentable invention under the circumstances of the case at bar must consist of two elements; first, the inventor must discover the working of a natural law; second, he must put that natural law to effective use. * * * Both elements, however, must be present to constitute patentable invention." (R. I, 674)

We are aware of no prior reported decision which enunciates such a rule of law in a patent case. The harshness of the rule, as may be immediately appreciated, would deny patentability to nearly every achievement of human endeavor. Ohm, Volta and Faraday would have practically foreclosed the field of electricity from the range of subsequent patentable invention. After Newton, no one could have validly patented a process newly applying the law of gravity, and yet this Court found the contrary in its well stated and much cited opinion, *Eibel Process Company* v. *Minnesota & Ontario Paper Co.*, 261 U. S. 45, where the gist of the invention was merely increasing the pitch of the screen of a Fourdrinier machine to give the stock the added force of the down hill flow, i.e., to allow gravity to speed the flow of the paper pulp.

Nor can Judge Biggs' statement below be supported by attenuating it. He says:

> "In the case at bar Hayduck cannot claim and does not claim to be the discoverer of the fact that the growth of the yeast may be stimulated by neutralizing

> the acid by an antacid. The operation of this natural law in respect to yeast was discovered by others before him * * *." (R. I, 674).

The fact is Hayduck *did* discover that the yield of yeast could be greatly increased not "by neutralizing the acid (Query: To what acid does the Court refer?) by an antacid"; but by an integrated combination of the steps (a) adding amounts of inorganic salts of great *potential* benefit, and (b) adding an antacid during propagation to neutralize the *deleterious excess* of the released inorganic acid to make the benefit *actual*.

Either step without the other was fruitless. The two in combination were revolutionary. His discovery of the combination process entailed also his discovery of the results which flowed from the combination of natural laws operative in his process—a combination of laws not operative collectively in any process of the prior art. He did discover a new combination of natural laws.

But Hayduck does not claim a law of nature, and indeed it is elementary that a mere law of nature is not within the scope of patentable subject matter (see, Walker on Patents, Dellers Edition, Vol. I, p. 62 *et seq.*). Hayduck does not claim mere results. Others remain entirely free to achieve the same or greater results. What patent -103 does claim and what was new and validly patentable is the combination of specified steps, in specified sequence and with certain specified mediums,—these comprise his defined process. Neither Henneberg, Wilfert, or Pollak, nor any other reference, ever taught that combination.

It is submitted that the above recited errors of fact and of law in the decision of the Court of Appeals for the Third Circuit make abundantly clear the error of its conclusion.

The history of the art before and since Hayduck's invention effectually disproves "obviousness" at the time he made it. The invention fully meets the standards of

patentability announced by this Court and is not met by the prior art. As Judge Soper said:

> "If the foreign patents and the Henneberg articles cited against the patent are compared with its disclosures, it will be seen that, so far as the step of neutralization in the manufacture of bakers' yeast is concerned, the former are vague and indefinite, while the latter makes specific and clear statements that the employment of alkaline substances are of great advantage in the quantity and quality of the product. It is one thing to show that, when yeast is used in fermentation processes, its fermentative power and duration of life will be enhanced by offsetting deleterious acidity or that in producing pure yeast cultures in the laboratory with distilled water, antacid substances should be used, and it is quite another to demonstrate that, when the end in view is the production of large quantities of yeast for its own sake, neutralizers may be advantageously employed. **As has so often been said in patent cases, it is the last step which counts.** Loom Co. *v.* Higgins, 105 U. S. 580, 26 L. Ed. 1177; Barbed Wire patent, 143 U. S. 275, 12 S. Ct. 443, 36 L. Ed. 154; Badische Anilin & Soda Fabrik *v.* Kalle (C.C.) 94 F. 163, affirmed in 104 F. 802, 44 C.C.A. 201; Permutit Co. *v.* Harvey (C.C.A.) 279 F. 713; Seymour *v.* Osborne, 11 Wall. 516, 20 L. Ed. 33; Loew *v.* German-American Filter Co., 164 F. 855, 90 C.C.A. 637." (8 F. (2d) pp. 197-198)

As to Patent –105

The Disclosure

The claims of this patent* (all of which are in suit) are drawn to new combinations of prescribed steps of manipulative control of nutrient solutions to effect improved yields of yeast, without the production of alcohol.

* Claims 4, 8. 9, and 10 were held valid in the second Maryland litigation, but the Court did not pass on the validity of the other claims (38 F. (2d) p. 338).

Claim 10 reads:

"A process of propagating yeast with a relatively low yield of alcohol which comprises,

preparing a wort containing all essential yeast nutrients in solution,

initiating propagation of yeast in a highly diluted portion of said wort,

aerating the diluted portion, and substantially continuously adding during the period of propagation,

the wort of higher concentration at a rate such that the concentration of the dilute wort remains substantially constant, whereby substantially all of the alcohol which may be formed is assimilated." (R. II, 7)

Judge Soper's opinion in the second Maryland suit describes the subject matter and its advantages as follows:

"The important feature of the process disclosed by this patent relates to the method in which the mash or wort is introduced into the propagating vat. A feeding process, referred to in the testimony as the Zulauf feed, is prescribed, whereby a comparatively small part of the nutrient solution is diluted, placed in the vat and seeded with yeast, and, after it has begun to grow and propagate, the remainder of the wort is fed in gradually to supply its increasing needs. As we shall see, this change has been accompanied by a great increase in the yield of yeast from raw material in the modern yeast factory."

* * * * * *

"The patentee states that by this method the yeast is constantly given new supplies of all nutriment necessary for its propagation, and there is always a wort concentration by means of which the nutriment is absorbed most efficaciously and quickly by the yeast. In other words, there is offered the advantage of great dilution, while the concentration of the wort calculated for the entire quantity remains the same. The advantage of this procedure is contrasted

with that customarily used in the manufacture of yeast, for therein propagation begins in a relatively concentrated solution and the concentration is decreased gradually during propagation." (38 F. (2d) 329, 331)

The opinion of the Circuit Court of Appeals below similarly states:

> "The patent contemplates the management of the process in such a wise that the nutrient solution will be kept at such a relatively low concentration that the amount of alcohol produced will never go beyond that which the feeding yeast can absorb. . . . The gist of the patent therefore is for a rate of feeding the wort into the nutrient solution already in the fermenting vat." (R. I, 681)

Reverting to the history of commercial yeast manufacture (*supra*, pp. 11-13), it will be remembered that all of the processes in use prior to petitioner's adoption of the –105 method in 1923 were alike in the respect that they were "straight-set", that is, the entire nutrient solution, i.e., the entire wort, was placed in the propagating vat at the start, and during the period of propagation the concentration of the nutrients gradually and progressively decreased.

As contrasted from all these "straight-set" methods, the patent –105 process divides the nutrient solution of relatively high Balling (i.e., concentration) into two portions of which only one is diluted to about 1° Balling and put into the propagating vat at the start. The other or reserve part of the solution is then added slowly and substantially continuously during propagation at a rate such that the concentration of the nutrients in the vat, instead of continuously decreasing, is maintained substantially constant. In other words the food for the yeast is continuously replenished as it is consumed.

The proper division of the initial thick solution into two discrete portions may be calculated by a rule which

the patent specification sets forth on page 1, lines 90 to 95 (R. II, 5), and of which it is sufficient here to say that the fractional division depends upon the Balling of the thick wort selected by the manufacturer and on the Balling (of the diluted part) at which the manufacturer wishes the propagation to begin. After the division is made and the minor portion in the propagating vat is adequately diluted, the patent directs:

> "Thereupon the remainder of the concentrated wort is added slowly and substantially continuously throughout a protracted period of time and at a rate such that not only the alcohol which may have been formed from the quantity of sugar present in the diluted portion of the wort, but also any alcohol which may be formed from the sugar which is present in the added wort, can be assimilated immediately by the yeast." (R. II, 5, ls. 74-84)

As Claim 10 of the patent points out, the reserve wort of higher concentration is substantially continuously added during the period of propagation

> "at a rate such that the concentration of the dilute wort remains substantially constant".

That means, if 1° Balling is selected for the initial dilution or concentration of wort in the vat, the remaining higher Balling wort (or the reserve) is fed in at such a rate that the nutrient added substantially equals the nutrient being consumed by the yeast and consequently the nutrient concentration in the vat remains substantially constant at 1°.

The patent further states:

> "* * * the process described above offers the advantage that the yeast is constantly given new supplies of all nutrient constituents necessary for its propagation by the continuous addition of concentrated wort, and that thereby as a result of the continual consumption of the nutrients by the yeast there is always a wort concentration, by means of which the nutrients and the resultant substances are

absorbed most efficaciously and quickly by the yeast * * *." (R. II, 5, ls. 98 *et seq.*)

The patent is directed particularly to this procedural or manipulative, rather than chemical, aspect of the operation; i.e., a division of the wort into two parts with propagation begun in a diluted fraction and the gradual feeding in of the concentrated reserve as stated. By adopting this perfected process, the yield of yeast was still further increased and there were also other accompanying advantages in shortened time from commencement of the yeast propagation to the harvesting of the yeast crop and in enhanced quantity of output from a given sized apparatus. Up to the date of trial petitioner had made over one billion seven hundred million pounds of yeast, using the Zulauf process generically covered by patent -105.

The Prior "Paper" Art Is Non-Anticipatory

The defense in the second Maryland suit and the defense in the present case both rested on arguments that before Hayduck it was known that the propagation of yeast was favored and the production of alcohol disfavored by conducting operations in a wort with a low sugar concentration, and that this item of knowledge taken in connection with the German patent to Rainer 10,135 (R. II, 135), deprived Hayduck's invention of any patentable novelty.

The District Court below did not refer to the prior art, resting its conclusion on a different ground. The opinion of the Circuit Court of Appeals below indicates that while it accepted the argument it was not certain of its position because it admitted that "the process described by Hayduck may constitute a mechanical improvement over the prior art" and continued "But even if the process disclosed by Hayduck be held to constitute invention, the patent is invalid for indefiniteness" as was held by the District Court (R. I, 683).

Judge Soper, in the second Maryland litigation, discussed the prior art at length (38 F. (2d) pp. 331-335), and clearly pointed out the reasons why the validity of patent –105 is unshaken by it.

1. Iwanowski Abstract (1903)

This abstract of another article in German (R. II, 157), is an example of the above mentioned prior art knowledge of the isolated fact that there is a tendency toward increased alcohol production in the presence of increased sugar concentration and obtainment of low alcohol yields in the case of lower sugar concentration (R. I, 215).

The abstract deals only with observations on operations of the "straight set" type, namely, where all of the nutrient solution is put into the fermenter at the beginning. This "straight set" type of process was uniformly employed in the industry for many years prior to Iwanowski (R. I, 216-217) and it was not until Hayduck's inventions of patents –105 and –106 that the yeast manufacturing art knew any method by which the abstruse knowledge of the Iwanowski article could be turned to practical advantage; until Hayduck high dilution of nutrient solution unavoidably entailed overbalancing disadvantages and expense.

Iwanowski was cited but not relied on in the second Maryland litigation. It shows no division of the wort into a minor diluted portion, and no addition of a concentrated reserve; it merely repeats the old knowledge that a high dilution tended toward lesser alcohol production. It shows nothing more than the statement at lines 23 to 32, page 1 of patent –105 (R. II, 5) and it is worthy of note that the Examiners in the Patent Office found the claims in suit allowable thereover. Judge Soper also held the patent valid over this prior art knowledge (38 F. (2d) p. 331) and even the Circuit Court of Appeals below did not hold that this isolated item of knowledge was of itself anticipatory of Hayduck's process.

2. Rainer German Patent of 1879

The subject matter of the Rainer patent is also referred to and disclaimed in the specification of patent –105 (R. II, 5; ls. 32-53); and the patent claims were allowed thereover.

In this patent, raw materials as cereals, corn, legumes, bran, malt sprouts, spent grains, gluten, etc. are employed as the chief source of "peptones"; and molasses or sugar is employed as the sugar source. Separate solutions of these ingredients are made. The wort in which propagation is to be begun is a mixture of the two in which the sugar is "always limited to no more than ½ to 1% of the weight of the total liquor", while the "peptone content of the mass may amount to 1 to 2% of the weight thereof". (R. II, 139). That is to say, the wort in which propagation is begun is diluted so that the sugar concentration disfavors alcohol production, and the peptone concentration is twice the sugar concentration.

Thereafter at about three hour intervals or when the "sugar has been consumed entirely or at least the greatest part thereof for the growth of the yeast, an additional portion containing from 1/20 to 1/10% is added and, likewise the peptones after having been consumed, can be added again to the liquor, * * *." (R. II, 139)

Rainer conducts his process so that the ratio of peptone to sugar in the wort in the propagating tank is 2 to 1 *at the start* of operations, and so that the peptone to sugar ratio over the operation as a whole is also 2 to 1. He points out also at the end of his specification that the yeast actually consumes peptone and sugar in the ratio of 1 to 2:

> "According to results obtained up to the present, from 250 to 300 kg of a pure and vigorous pressed yeast can be obtained from every 100 kg of pure peptone (dry weight), only about 200 kg of dextrose or sugar being required for its cultivation." (R. II, 140)

Judge Soper states:

> "This seeming contradiction in the ratio between the substances actually consumed and that existing during the growth of the yeast is due to the fact, as the experts agree, that all of the peptone in the material is not assimilable by the yeast, and that consequently the sugar is consumed faster than the peptone." (38 F. (2d) 329, 333-4)

Both Judge Soper and Judge Biggs (below), found that Rainer disclosed adding the peptones continuously and the sugar at intervals (38 F. (2d) p. 335; R. I, 682).

As a result of Rainer's suggested procedure the nutrient content and composition and the Balling thereof in his propagating tank fluctuate and are not maintained constant, and as Judge Soper pointed out:

> "* * * Rainer had no clear perception of the advantages to be derived from a continuous feed and a substantial constancy of material constituents of the wort, * * *" (38 F. (2d) p. 335)

as disclosed by Hayduck.

In the Baltimore case there was evidence that following Rainer's preferred process the yeast yield would be only 5% on the basis of the raw materials. Judge Soper held:

> "This testimony was disputed, but, without discussing the matter in detail, it is sufficient to say that the evidence that the yield would be unsatisfactory commercially is convincing." (38 F. (2d) p. 338)

In the present case, respondent's witness Free testified as to conducting *ex parte* what he alleged was a duplication of the Rainer process. It appeared that he employed peptones from malt sprouts and sugar from molasses. It appeared under cross examination that he incorporated important departures from the Rainer process; but, he alleged his yeast yield on the basis of peptone and molasses was 53% (R. I, 296). The true basis of calculation should have been with respect to the cereal materials and

the molasses as respondent's expert admitted. These cereal materials from which Rainer makes his peptone must be considered in arriving at the cost of Rainer's raw materials.

Now, the witness admitted that his peptone extract represented only about one-third of the malt sprouts.

> "XQ. 179. Well, have you any data from which you can give us the figure of the amount of peptone you obtained from the raw material sprouts?
> A. Well, that is one-third." (R. I, 294)

It thus appears that the witness obtained a yield on the true basis of raw materials of only 20%. This is arrived at as follows: Since Rainer says the yeast crop consumes peptone and sugar in the ratio of 1 to 2, whereas these materials are supplied in the wort in the ratio of 2 to 1, it means that three-quarters of the peptone is not assimilated. For the purposes of the wort, therefore, assuming 100 units of sugar there is necessary to supply 200 units of peptone, or 300 units combined, and since the witness Free said he obtained a yield of 53% on such materials, that means that his yeast yield would have been 159 units. Since, however, to get the 200 units of peptone required 600 units of malt sprouts, his true starting materials were 600 units of malt sprouts, plus 100 units of sugar, a total of 700 units, and on this basis the 159 units of yeast crop gave a yield of about 20%.

Respondent's experiments thus confirm Judge Soper's above quoted holding as to Rainer, that "the yield would be unsatisfactory commercially". If further confirmation of this fact be needed it is to be found in the book published in 1912 by the well recognized authority Kiby entitled "Handbook of Pressed Yeast Manufacture" which states:

> "Dr. Rainer in Vienna obtained in 1879 a patent for the manufacture of compressed yeast without the production of alcohol; much peptone and a little sugar were brought to fermentation; nevertheless **the process did not come to a successful realization.**

All the large scale experiments to that end were uniformly unsuccessful." (R. I, 441)

Comparing even respondent's test results with the summarized history of the commercial processes in use in the United States (*supra*, pp. 11-13), it would appear that the Rainer process would have been a step backword from the results obtained commercially even as early as 1911, and would have given little more than half of the yields obtained in 1913. It would be only one-quarter of the yield obtained by the process under Hayduck's patents –105 and –106.

In the face of this difference between a step backward and a step forward, we contrast the conclusion of the Circuit Court of Appeals below:

> "We are convinced, however, that there is little difference in substance between beginning fermentation with a wort at 1° Balling and adding nutrient solution at 12° Balling from time to time to prevent the excess production of alcohol as taught by Hayduck and beginning the fermentative processes with such a low concentration of sugar in the nutrient solution that the feeding yeast will not produce excessive alcohol as taught by Rainer * * *." (R. I, 682).

with the opinion of Judge Soper:

> "The regulation of the rate of addition so that the yeast may propagate and substantially all the alcohol formed may be assimilated, and the maintenance of substantial constancy of concentration of nutriment, through regulation of the rate of addition, are not found in any reference in combination with the other elements expressed in these (Hayduck –105) claims.
>
> * * * * * * *
>
> Certainly a skilled worker, with the Rainer patent before him, together with the statement of its impracticability,* would not be justified in concluding

* Judge Soper was here referring to the statement in Kiby's book quoted above.

that the disclosure of the patent was of much practical value. On the contrary, he would be led to search for the defects in the process so as to take the last step in order to transform failure into success. As the evidence indicates that Hayduck has rendered this service, the patentability of his disclosure is established," (68 F. (2d) pp. 337-338) (Parenthetical insert ours).

No witness for respondent ventured to testify that Claim 10, for example, of patent –105 was anticipated by anything disclosed in the Rainer patent; nor has respondent yet advanced that assertion. We have then a conceded difference and a conceded measure, in practical results, of the difference. We have the fact that for an interval of thirty-seven years the disclosure of the Rainer patent did not make obvious the process of patent –105. We submit that Hayduck's improvement required the exercise of patentable invention and that the patent is valid over the prior art.

The Patent Is Not Indefinite

As pointed out *supra*, the Circuit Court of Appeals below was not convinced of the logic of its decisions, and therefore added:

"But even if the process disclosed by Hayduck be held to constitute invention, the patent is invalid for indefiniteness as was held by the learned District Judge. Both the times and manner in which the concentrated nutrient solution is to be added may be ascertained as we have stated solely by experimentation. * * *

It is settled that if the disclosure of a patent is so indefinite as to require independent experiments, the patent is void." (R. I, 683)

The Court here refers to the adequacy of disclosure regarding the rate of addition of the concentrated reserve wort into the diluted fraction of the wort in the propagating tank during propagation. The facts are as follows:

Hayduck -105 makes a complete concentrated nutrient solution of relatively high Balling, a 12° Balling solution being referred to in the example (R. II, 5, l. 67); obviously the concentration of the reserve might be made 5° or 25° Balling, as the individual manufacturer might prefer. The patent then takes a predeterminable fraction of this relatively concentrated solution and dilutes it in the propagating tank to a relatively thin solution, the example refers to 1° Balling (R. II, 5, ls. 70-72); obviously it might be ¾° Balling or 1½° Balling, as the individual manufacturer might prefer. As admitted by respondent's expert (R. I, 575, Q. 528), if the propagation is begun with a relatively small amount of seed yeast, the rate at which the nutrients would be consumed will be slower than the rate of consumption if a relatively large amount of seed yeast is employed. It thus is manifest that the rate of feeding the more concentrated solution will vary in accordance with the selected concentration of nutrients in the reserve wort and in the diluted wort and will also vary in accordance with the amount of seed yeast present at the beginning of the propagation. The rate of feed quantitatively in gallons per hour will vary, therefore, dependent on the particular starting conditions chosen. The *relative rate of feed*, however, in all cases remains fixed, namely, that the reserve shall be substantially continuously added so that the concentration of nutrients in the dilute portion shall remain substantially constant; in other words fresh nutrients shall be added at substantially the same rate that nutrients are consumed by the yeast.

The Circuit Court of Appeals below, therefore, falls into plain error of fact in holding that "the times" in which the concentrated nutrient solution is to be added may be ascertained solely by experimentation. On the contrary, the Hayduck patent explicitly states that the concentrated reserve shall be added "substantially continuously" (R. II, 5, ls. 75-76).

The Court below erred likewise in holding that the "manner" of addition must be determined solely by experimentation. The patent states that the reserve shall be fed "slowly" and "at a rate such that the concentration of the dilute wort remains substantially constant" (Claim 10).

If the Balling of the diluted portion in the tank where propagation is occurring is at 1°, this means that the reserve shall be fed in so that the nutrient concentration in the tank remains substantially constant at 1°. That in turn means that the operator, who is conducting the process, has merely to watch the Balling of the solution in the propagating tank and if the concentration begins to decrease below 1° he increases the rate of reserve feed to raise it again to 1°, and conversely if the concentration in the tank tends to increase over 1°, he reduces the rate of the feed so that the concentration is restored to 1°.

This contracts the inquiry to, how may the operator ascertain the degree Balling? The evidence is uncontradicted on this. Petitioner's witnesses Lamb (R. I, 458) and Field (R. I, 388), and respondent's witnesses Rautenstrauch (R. I, 206) and Free (R. I, 270), all agree that the art had a simple instrument of measurement, namely, a saccharimeter, the use of which to determine concentration was a normal thing. This is merely a float with graduations marked in degrees Balling, and the depth at which the instrument floats in the wort can be read directly to indicate density of the wort. If the density of the wort is high, the float will not sink so far down in it as if the density is low (R. I, 394). Such a routine observation is not an "experiment", it is a normal control test.

An analogy might be found in an instruction to let a liquid flow from a faucet into a leaky pail at a rate such that the level of the liquid in the pail would remain constant. Obviously the size of the holes in the pail might vary, the rate of leakage might vary and the den-

sity of the liquid might vary, so no quantity rule in gallons per unit of time could be set forth; but it would be within easy comprehension of the most unskilled when so directed, merely to watch the liquid level in the pail and open the faucet further if the level tended to drop or shut it some if the level tended to rise.

Another analogy would be to give instruction to a furnace tender to maintain a constant steam pressure in a boiler. He would then have merely to observe the steam gauge and, if it dropped, open the draft and add more coal, whereas if it rose, he would close the draft and not replenish the fuel so rapidly. The exact number of pounds of coal fed would depend on the furnace size, the kind of coal, the size of the fire in the furnace, the draft used, etc., but the direction to keep the steam pressure constant would be sufficient direction for a skilled furnace operator.

The saccharimeter being a common tool in the yeast manufacturing art, the only question before the Court on the issue of sufficiency of disclosure is whether an instruction to maintain a density gauge condition substantially constant is an instruction that requires "independent experiments and investigations", which render the patent ambiguous and inoperative; or is one that can be followed by the ordinary skilled worker in the art and makes the disclosure sufficient. The normal use of such an instrument cannot properly be called experimentation. Respondent's witness Rautenstrauch admitted that during the period of propagation the amount of yeast increases, and that the patent: "teaches one skilled in the art to feed in (the reserve nutrient solution) at an increasing rate in accordance with the food requirements of the yeast as it multiplies (R. I, 238). To do this and thus keep the density substantially constant does not involve experimentation.

We believe the question answers itself. If as the Court below held, the instruction is so ambiguous as to render the patent invalid, the alternative in the patent would have been to write an encyclopedic specification in which quanti-

tative amounts in terms of gallons per hour should have been recited for all the infinite permutations of reserve and dilute Ballings, types of nutrients, and amounts of seed yeast possible. This is not required of a patentee:

> "The law requires every inventor, before he can receive a patent, to furnish a specification or a written description of his invention or discovery, and of the manner and process of making, constructing, using and compounding the same, in such full, clear, and exact terms, avoiding unnecessary prolixity, as to enable any person skilled in the art or science to which it appertains, or with which it is most nearly connected, to make, construct, compound, and use the same. The specification, then, is to be addressed to those skilled in the art, and is to be comprehensible by them. It may be sufficient, though the unskilled may not be able to gather from it how to use the invention. And it is evident that the definiteness of a specification must vary with the nature of its subject. Addressed as it is to those skilled in the art, it may leave something to their skill in applying the invention, but it should not mislead them."

Mowry v. *Whitney*, 81 U. S. 620, 644.

See also:

Eibel Process Company v. *Minnesota & Ontario Paper Co.* p. 66; *supra*, p. 11.

The conclusion of the Circuit Court of Appeals below rests on a statement of fact which is plainly erroneous, and rests likewise on a misapprehension of the law. The patent sets forth a fully operative disclosure and is not invalidated by the prior art.

As to Patent –106

The facts and issues with respect to this patent can be most briefly stated.

The Process Disclosed and Its Utility

It is here stipulated (R. I, 38) and the Courts both in Maryland and in the Third Circuit have held, that this patent* comprises the features of patent –103 and the features of patent –105 combined into a single integrated process (38 F. (2d) p. 342; R. I, 683).

This integrated process obviously combines all of the advantages of the processes disclosed in patents –103 and –105 and it was by this "last word" process that the most of the one billion seven hundred million pounds of yeast were made by petitioner up to the date of trial (i.e. petitioner's D.M. process, described by its witness Luce, R. I, 105).

The utility of the patented process is also shown by the fact that the defendant in the second Maryland litigation appropriated it in a number of its processes which were found to infringe (38 F. (2d) p. 351).

Patents –103 and –105 Are Not Prior Art to Patent –106

Judge Soper held that patents –103 and –105 did not constitute prior art against patent —106, because of common inventorship and copendency of applications and because the claimed subjects matter were distinct. In support of this holding, he found:

> "It has been held that, in the case of copending applications by the same inventor relating to the same art, it is not necessary to the validity of the claims of the later application that they should embody a patentable advance over the earlier disclosure. The test is not whether the step between the earlier and later claims required invention. It is sufficient that the claims are for separate inventions."

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* Claims 1, 3, 4, 5, 6, 8, 12, 13 and 15 are in suit, and of these, all except claim 15 (not there in suit) were held valid and infringed in the second Maryland litigation (38 F. (2d) p. 342).

(Citing Traitel Marble Co. *v.* U. T. Hungerford Brass & Copper Co., 22 F. (2d) 259, 260, (C. C. A. 2); MacGregor Co. *v.* Vaco Grip Co., 2 F. (2d) 655, 656 (C. C. A. 6); Montgomery Ward & Co. *v.* Gibbs, 27 F. (2d) 466 (C. C. A. 4); Toledo Scale Co. *v.* Computing Scale Co., 9 F. (2d) 823 (C. C. A. 6); Deister Concentrator Co. *v.* Deister Mach. Co., 263 F. 706 (C. C. A. 7); Theroz Co. *v.* United States Industrial Chemical Co., 14 F. (2d) 629, 639 (D. C. Maryland)).

"It is clear that the claims of patent 106 are not the same as the claims of the prior patents. Some of the claims of patent 106 contemplate the application of the Zulauf feature of patent 105 to a special kind of mash, and other claims of patent 106 involve a combination of the important features of patent 103 with those of patent 105. Neither of the earlier patents lays claim to a process which involved the use of the feeding process of one patent together with the neutralization of the other." (38 F. (2d) pp. 343-344)

Other cases in point are:

The Suffolk Co. v. *Hayden*, 3 Wall. (70 U. S.) 315, 318;

American Hatters & Furriers Co. v. *Danbury & Bethel Fur Co.*, 47 F. (2d) 268, 269 (aff. 54 F. (2d) 344, C. C. A. 2);

Anderson v. *Collins*, 122 Fed. 451, 458 (C. C. A. 8).

The Circuit Court of Appeals below makes its holding *contra* in great brevity and without citation of authority, it merely says:

"Since we have found patents Hayduck -103 and Hayduck -105 to be invalid it follows that we find this patent to be invalid, since combining the process of invalid process patents cannot result in validity." (R. I, 684)

The Circuit Court obviously erred in thus holding that patents -103 and -105 constituted prior art for any purpose against patent -106.

The Prior Art Is Non-Anticipatory

If, on the other hand, the Circuit Court of Appeals below meant to hold that the prior art (Henneberg, Wilfert and Pollak) which it held to invalidate Hayduck –103, *plus* the prior art (Rainer and Iwanowski), which it found to invalidate patent –105, might be combined to invalidate patent –106, then its conclusion again amounted to a holding that the existence of isolated piecemeal and vague disclosures in the prior art automatically eliminated room for the exercise of patentable invention in combining several steps into a new and useful unitary combination, despite evidence that the patented combination revolutionized the industry. Such a conclusion is equally repugnant to equity and contrary to sound established patent law, as previously held by this Court:

Leeds & Catlin v. *Victor Talking Machine Co.*, *supra*, p. 20;

Parks v. *Booth*, *supra*, p. 21).

Finally, if the Court meant to indicate that it was its holding of invalidity of the patents –103 and –105, which rendered the patent –106 invalid, then we find neither rhyme nor reason in such holding. Certainly the combination of distinct processes of separate patents into a single unitary process might involve the highest exercise of patentable invention, and how the validity or invalidity of the two separate patents could affect the question of the validity of the third is unperceivable.

In any event, the law has heretofore been applied in the cases above cited, by this Court and by the Circuit Courts of Appeals for the 2nd, 4th, 6th, 7th and 8th Circuits, contrary to the Circuit Court of Appeals for the Third Circuit herein.

CONCLUSION

The reasoning expressed in the opinion of the Court below in finding each of the patents here on review invalid is manifestly unsound and is unwarranted either by the facts or the law of the case. Petitioner invites a careful comparison of the prior opinions in the Maryland litigations with the opinions below. It is apparent that they are in irreconcilable conflict and that the understanding of the subject matter and the application of the law which they reflect is in sharp contrast.

The Circuit Court of Appeals below found patents -103 and -105 invalid on the basis of vague, indefinite and incomplete in publications of foreign origin despite the fact that the same or substantially the same art had been before the Officials of the Patent Office, who had allowed the claims in suit thereover; and it apparently disregarded the facts that such prior art had been without any effect on the yeast manufacturing industry for many years and that the patented inventions revolutionized the industry.

As this Court said in *Diamond Rubber Co.* v. *Consolidated Rubber Tire Company*, 220 U. S. 428, 435 and 441:

> "Knowledge after the event is always easy, and problems once solved present no difficulties, indeed, may be represented as never having had any, and expert witnesses may be brought forward to show that the new thing which seemed to have eluded the search of the world was always ready at hand and easy to be seen by a merely skillful attention. But the law has other tests of the invention than subtle conjectures of what might have been seen and yet was not. It regards a change as evidence of novelty, the acceptance and utility of change as a further evidence, even as demonstration."
>
> . . . . . .
>
> "That the tire is an invention is fortified by all of the presumptions, the presumption of the patent by that arising from the utility of the tire. And we have

said that the utility of a device may be attested by the litigation over it, as litigation 'shows and measures the existence of the public demand for its use.'"

As was aptly said by the Circuit Court of Appeals for the Second Circuit in the case of *O'Rourke Engineering Const. Co.* v. *McMullen et al.*, 160 Fed. 933, 939 (C. C. A. 2), above quoted, p. 18:

> "The keynote of all the decisions is the extent of the benefit conferred upon mankind. Where the court has determined that this benefit is valuable and extensive it will, we think, be difficult to find a well considered case where the patent has been overthrown on the ground of nonpatentability."

It is submitted that, as respects the validity of the Hayduck patents –103, –105, and –106, the prayer of the petition should be granted and the ruling of the Third Circuit Court of Appeals reversed.

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IN THE

Supreme Court of the United States

OCTOBER TERM—1939

No. 9

STANDARD BRANDS INCORPORATED,
Petitioner,

vs.

NATIONAL GRAIN YEAST CORPORATION,
Respondent.

REPLY BRIEF FOR PETITIONER

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Respondent's argument against the validity of the patents boils down to the contentions that it was within the skill of the ordinary worker, and did not involve the exercise of patentable invention:

First, to combine the step of using inorganic ammonium salts as a substantial source of nitrogen and the step of neutralizing the deleterious excess of developed inorganic acidity during propagation, into a unitary yeast propagating process (patent –103); and

Second, to combine the step of initiating propagation in a diluted fraction of wort and the step of feeding in concentrated reserve wort during propagation to maintain the dilution (i.e. nutrient content) in the vat substantially constant, into a unitary process of yeast propagation (patent –105); and

Third, to combine the four steps of using inorganic ammonium salts as a substantial nitrogen source, initiating propagation in a diluted fraction of nutrient solution, neutralizing the deleterious excess of developed inorganic acidity during propagation, and feeding in concentrated reserve solution at a rate to maintain the dilution (i.e. nutrient content) in the vat substantially constant, into an integral process of yeast propagation (patent –106).

It is believed that the unsoundness of these contentions sufficiently appears from the chemical and technical facts set forth in detail in Petitioner's Main Brief and judicially marshaled in the decisions of the prior litigation reported at 8 F. (2d) 186, 13 F. (2d) 570 and 38 F. (2d) 329.

The propriety of adopting or rejecting the contentions may also be tested fairly from a more non-technical approach, as follows.

As to the –103 Patent

Respondent advances the Jacquemin British patent dated 1896 (R. II, 127) and the Fritsche Austrian patent dated 1895* (R. II, 154) to show that the discrete step of employing inorganic ammonium salts in a nutrient solution was old. It advances the Wilfert Article dated 1890** (R. II, 171) to show that the discrete step of neutralizing acidity was old.

This means that for twenty years before Hayduck the art had before it knowledge of the first step separately

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* Jacquemin gave no indication of the amounts of inorganic salts or of yeast yields and, while Fritsche states amounts, he states that the process brought about a yield increase in one case by as much as 3½% and in another case by as much as 12%. Such slight improvements are to be contrasted with Hayduck's patent –103 improvement in yield of nearly 100%.

** Wilfert of course dealt with a step entirely *preliminary* to yeast manufacture, and effectuated no neutralization *during propagation.*

and knowledge of the second step separately, which steps respondent contends were combinable obviously and without patentability to render the Hayduck 103 patent invalid.

The non-technical, but extraordinarily pertinent, question thereby presents itself of why, if the combination was obvious, no worker in the art for twenty years made that combination; and particularly why was it so long not done when its later doing brought about all the advantages of increased yield, better quality and economies which the record concedes to have occurred?

This Court has posed that question often, and has emphasized its telling significance, as follows:

> "But it is plain from the evidence, and from the very fact that it was not sooner adopted and used, that it did not, for years, occur in this light to even the most skilful persons. It may have been under their very eyes, they may almost be said to have stumbled over it; but they certainly failed to see it, to estimate its value, and to bring it into notice. Who *was* the first to see it, to understand its value, to give it shape and form, to bring it into notice and urge its adoption, is a question to which we shall shortly give our attention. At this point we are constrained to say that we cannot yield our assent to the argument, that the combination of the different parts or elements for attaining the object in view was so obvious as to merit no title to invention. Now that it has succeeded, it may seem very plain to any one that he could have done it as well. This is often the case with inventions of the greatest merit. It may be laid down as a general rule, though perhaps not an invariable one, that if a new combination and arrangement of known elements produced a new and beneficial result, never attained before, it is evidence of invention." (*Loom Company* v. *Higgins*, 105 U. S. 580, 591)

> "The fact that in a decade of an eager quest for higher speeds this important chain of circumstances had escaped observation, the fact that no one had applied a remedy for the consequent trouble until Eibel, and the final fact that when he made known

his discovery, all adopted his remedy, leave no doubt in our minds that what he saw and did was not obvious and did involve discovery and invention." (*Eibel Process Company* v. *Minnesota & Ontario Paper Company*, 261 U. S. 45, 68)

"Many things, and the patent law abounds in illustrations, seem obvious after they have been done, and, 'in the light of the accomplished result,' it is often a matter of wonder how they so long 'eluded the search of the discoverer and set at defiance the speculations of inventive genius.' *Pearl* v. *Ocean Mills*, 11 Off. Gaz. 2. Knowledge after the event is always easy, and problems once solved present no difficulties, indeed, may be represented as never having had any, and expert witnesses may be brought forward to show that the new thing which seemed to have eluded the search of the world was always ready at hand and easy to be seen by a merely skillful attention. But the law has other tests of the invention than subtle conjectures of what might have been seen and yet was not. It regards a change as evidence of novelty, the acceptance and utility of change as a further evidence, even as demonstration." (*Diamond Rubber Company* v. *Consolidated Rubber Tire Co.*, 220 U. S. 428, 434-5)

Respondent's brief offers no answer to that inquiry. The Circuit Court of Appeals decision below perhaps implies that the War for the first time made the combination commercially desirable, by saying:

"In later years, particularly during the course of the World War which required conservation of grains, molasses was used as the source of sugar in the making of nutrient solutions in lieu of cereals. In 1919 inorganic salts capable of nourishing yeast were used in place of organic nitrogenous materials." (R. p. 672)

Respondent's witness at the trial attempted to explain the failure of the art until Hayduck to combine the steps constituting the process of patent -105 by saying that the World War in Europe and Prohibition in the United States made such process for the first time economically

desirable,* but, did not give this explanation or any other for the failure of the art to combine the steps constituting the process of patent –103.

It is not disputed that the benefits of doubled yield, improved quality, and others resultant from the process of patent –103 would have been just as valuable for twenty years before Hayduck's invention as during the time since. It is believed to be more reasonable to conclude, therefore, that the failure of the art for twenty years to combine the steps into the unitary process constituting the claimed invention of patent –103 is attributable to the inability of the workers in the art to do so; and as a corollary that Hayduck, when he did so, exercised patentable invention beyond the skill of the ordinary worker.

This conclusion moreover harmonizes with the other known facts. For example, the prior knowledge of the separate step of using inorganic salts was that such use was of slight commercial advantage. Jacquemin in 1896 indicated no advantage whatever and Fritsche in 1895 indicated an increase of yield by as much as 3½% in one case and by as much as 12% in another. Wilfert in 1890 utilized the discrete neutralizing step preliminary to any yeast propagation, and indicated no improvement in yield. Moreover, Wilfert's discrete step had been proved unpromising as indicated by its characterization in another reference in the record (American Distillers' Review, dated 1914, R. II, 161),** which states:

> "One may work according to the Wilfert or other sulphuric acid methods which specify from 0.8 to 3.6 degrees of acidity, **but these methods are uncertain and full of trouble.**" (Emphasis ours throughout)

Respondent's Brief at various places (for example pages 6, 10, 16) states that the "prior art knew that a yeast wort should be *maintained* slightly acid". The references just mentioned and others cited by respondent do not

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* This explanation will be discussed presently (p. 9).

** This reference was not mentioned by the Court below.

support this statement. Wilfert (R. II, 171), and American Distillers' Review (R. II, 161), Molhant British patent (R. II, 133) and Pollak, Swiss patent (R. II, 151) dealt solely with the acidification of the wort prior to any propagation of yeast therein. In other words, so far as they suggested a favorable slight acidity, the suggestion concerned merely the acidity of the wort before yeast manufacture began. None of these references suggested any control of the acidity of the nutrient solution during the yeast propagating period, and it elsewhere appears in the record that the practical yeast art never added an antacid to the wort during the propagating period (R. I, 337).

To make a thing "obvious", and therefore devoid of the exercise of patentable invention in the sense of the patent law, it is necessary to show that the desirability of the combination and the actual putting together of the steps, that is, the making of the combination, were both obvious from the prior art. In the present case, respondent's evidence lacks any prior art reference to supply the first of these requirements, namely, to indicate the desirability and utility of the Hayduck combination.

The Henneberg references (R. II, 158; and 163) do not supply this missing link. Henneberg expressly denied the desirability or utility of the combination in any commercial yeast manufacturing process by saying that inorganic ammonium salts were innocuous in ordinary tap water, such as used by the yeast manufacturer. Even in the case of distilled water these Henneberg references indicate no benefit by way of improved yield of product or any other economies from the step of neutralizing released acidity.* The full Henneberg references, mere abstracts of only one of which are in the present record, were in the record in the Maryland litigation on the -103 patent, and as Judge Soper points out in his decision there:

* Henneberg's neutralization was not controlled for the "deleterious excess" of acidity.

"No firm conclusion can be drawn from this study of the beneficial effect of chalk upon the quantity of yeast. On the contrary, one who sought guidance chiefly for the production of yeast in large quantities would be led to abandon rather than to adopt the addition of chalk."

"Dr. Lamb testified without contradiction that from a careful examination of the tabulated results, he had ascertained that, in experiments with race 12, either much or very much yeast was obtained without the use of chalk in 4 of the 5 ammonium solutions, and in nearly every instance with some one or the other of the remaining 6 yeasts, some yeast growth was obtained in all of the 5 solutions without the addition of chalk. When he added the chalk, there is only a single instance where much yeast was reported. That instance is solution 5. With it there are several instances cited where yeast growth occurred when chalk was used, but with the same solution there are similar statements about the growth of yeast before the addition of chalk." (8 F. (2d) 186, 194)

Henneberg's 1907 and 1908 laboratory experiments did not convey, even to him, the significance now assigned to his article by respondent. His "Prakticum" of 1909 made no mention of the possibility of using inorganic ammonium salts with neutralization of deleterious acidity in yeast manufacture. (Petitioner's Main Brief, p. 28). Respondent's Brief (p. 18) now argues that his 1909 book may have been written before his 1907 and 1908 experiments were conducted. But the textbook shows the contrary, as Judge Soper's opinion pointed out,

"The character of the work is such as to lead one to expect that such a disclosure would be made if the author were in possession of the fact. It is quite clear that he included the results of his most recent investigations of the two prior years. If it were obvious to him that he had made a discovery of great practical value in the manufacture of yeast, it is difficult to understand why he would not have told it while freely making public other matters which were of value in the fermentation industries." (8 F. (2d) 186, 196).

It is submitted that the failure of any one in the art for twenty years to do what respondent says was obvious when done, compels the conclusion in common sense and sound law that it was beyond the skill of the ordinary worker and called for the exercise of patentable invention.

As to the -105 Patent

The same question arises here. If combining the step of initiating propagation in a highly diluted nutrient solution and the step of constantly feeding in a concentrated reserve solution at a rate to maintain the dilution (i.e. nutrient content) in the propagating vat substantially constant, was obvious, why did the art fail so long in making this combination? This question was asked respondent's witness Rautenstrauch. He had admitted under cross examination that, despite Rainer (R. II, 135) dated 1879, the entire industry until Hayduck's date had adhered to the invariable practice of a straight-set mash (that is, the whole nutrient solution, of relatively high density, was placed with the seed yeast in the propagating vat at the beginning of the process), and had therefore failed to make practical use of the knowledge that if the propagation were conducted in a highly dilute solution the nutrients would be assimilated in the production of increased yeast yields and decreased alcohol yields. This appears as follows:

> "XQ. 387. Inasmuch as you have stated that the commercial practice for the period of thirty-six years included the use of straight set mashes and the use of such mashes of relatively high Balling, is it your opinion that that commercial practice departed from the use of relatively high dilutions of sugar because the use of relatively high dilutions of sugar would have entailed other and overbalancing disadvantages?
> A. No sir." (R. I, 233)

He was then asked to give his explanation why the art for thirty-five years or more had declined to do what respondent argues was a matter of routine. The testimony is:

"XQ. 388. In your opinion, what is the reason the art persisted for thirty-five years or more in using high Balling straight set worts?

A. I will be very glad to answer that question, sir. Prior to 1914, and years perhaps prior to that, the desire was to create yeast and alcohol. All during that period the art was advancing and developing and people learned how to produce yeast without much alcohol by having dilute solutions, but, as in many arts, it was not availed of until commercial circumstances made it desirable. We find that in almost all the arts. The commercial circumstances which made it desirable were, in this country Prohibition; in Germany, particularly, the desire was to grow yeast for its food value, particularly for stock food. Germany was then at war, was pressed for food for its—

Mr. Watson: Can we confine the answer, if the Court please, to United States practice?

Mr. Philbin: That wasn't the question, your Honor.

The Witness: I am answering the question.

The Court: Proceed, Doctor.—

A. (Continuing) In Germany, the desire for stock food was so pressing that these people began to avail themselves of what was known in the art, and from the fact that the art had been so thoroughly developed in regard to the possibility of growing yeast without alcohol they could do it quickly, there was no long period of experimentation, and the Germans immediately got into the production of yeast instead of alcohol, and were able to do so because of this art which had been established; and it is because of these commercial conditions that that conversion was made, and because of the fact that this art was revealed in the literature and the patents they could do it quickly, and there was no long period of experimentation.

XQ. 389. You say the desire influenced the commercial practice, and you stated that the desire was to make yeast and alcohol. Can we go a little further back and say that the manufacturer's desire and the usual and normal desire was to get products of the greatest value from his given raw materials?

A. In Germany that value being measured in nutrition for cattle, and that was the value which they were seeking. In the United States the value of alcohol

was destroyed by Prohibition; unless, of course, you wanted to be a bootlegger." (R. I, 233-235)

This explanation, on its face, might seem plausible. But further cross-examination immediately brought out that the explanation had been arrived at by the witness on *post hoc, ergo propter hoc* logic. The soundness of the explanation depended of course on the facts as to relative values of yeast and alcohol during this interval, *and the witness had no knowledge of these values.*

"I do not know the fair, typical selling prices of bakers' yeast or alcohol over the period from Rainer to 1916 in general or any particular portion of this period." (R. I, 235)

On the other hand, petitioner's witness Kaltenbach, who had been with the Fleischmann Company about fifty-five years, did know the facts, and showed that the assumption that Rautenstrauch had made in his explanation was totally unsound. Kaltenbach's testimony was:

"Q. 11. And can you give me comparative figures as to the value of yeast produced from a gallon of molasses with an 80 per cent. yield, as compared to the value of the alcohol which you produced in a straight fermentation for alcohol from that molasses?

A. The yeast was decidedly better value." (I, 331)

* * * * * * *

"Q. 18. * * * Can you tell me whether or not the Fleischmann Company was always interested in increasing its production of yeast?

A. Yes.

Q. 19. And decreasing the alcohol yield?

A. Yes.

Q. 20. I believe the question is whether or not it was interested.

A. They were always anxious to increase their yeast yield." (R. I, 332)

and further:

"XQ. 39. Considering these gallons of molasses that you used to make some alcohol, and to make some

yeast out of, you got a certain amount of money for the yeast that you got from that molasses, and a certain amount of money from the alcohol, can you tell us which item was the most profitable to you; not which item you got the most in gross return, but which you made the most money out of?

A. The yeast business. It was the business of the firm. They strove to develop that. All their energies were directed to selling yeast and producing it.

At times we lost money on the alcohol we sold. I don't recollect that that was ever true of the yeast business." (R. I, 334)

The 1892 Polsky British patent (R. H, 123) also shows that the higher value of yeast was then known, and greater yeast yield was being sought.

Petitioner's expert witness Lamb also testified that Rautenstrauch's assumption was unsound, as follows:

"Q. 388. On pages 233 to 235 of the record defendant's witness, Dr. Rautenstrauch, expressed the opinion that the yeast industry continued to use straight-set high Balling mashes for 35 years or more prior to Hayduck's invention patents in suit, particularly '105, because until 1915 the operation which is patented and which is the subject of this suit, would not have been useful and that it became useful in Germany on account of the war and in the United States on account of Prohibition. Do you agree with Dr. Rautenstrauch's conclusion?

A. No, I cannot believe that. The great advances which these inventions made possible in yeast manufacture had a utility and have a utility wholly independent of their utility during the war or during Prohibition. Of course it is evident that if that were not the case these patents would not have been carried on subsequent to the war or subsequent to the repeal of Prohibition. The patents recorded a real technical advance which made them valuable, irrespective of those special factors which were operative during the war and during Prohibition." (R. I, 401)

It thus is established that the stale-mate of the art from the date of the reference (Rainer, 1879) which respondent

asserts made Haydúck's –105 process obvious, was not at all for the reason advanced by respondent's witness Rautenstrauch.

We submit it as more reasonable to conclude that this history of the art is consistent only with the characterization of the –105 process as beyond the mere skill of the ordinary worker. Moreover, this conclusion is also harmonious with and confirmed by other record facts.

For example, the practical art could glean no indication from Rainer that the step of initiating propagation in a highly dilute wort nor the step of continuously adding supplemental nutrients to maintain substantially constant nutrient content during propagation was a practical thing to do. This is established by the present record in two ways. First, and as Judge Soper pointed out (38 F. (2d) 338), Kiby in his Handbook of Pressed Yeast Manufacture, dated 1912, sets forth:

> "Dr. Rainer in Vienna obtained in 1879 a patent for the manufacture of compressed yeast without the production of alcohol; much peptone and a little sugar were brought to fermentation; nevertheless the process did not come to a successful realization. All the large scale experiments to that end were uniformly unsuccessful." (R. I, 441)

Second, as Judge Soper there also pointed out, the Rainer process resulted in uncommercial yeast yields. A counterpart of this evidence is offered by the present record where respondent's witness, Free, conducted *ex parte* experiments purporting to duplicate the Rainer disclosure. Petitioner commented on these experiments in its Main Brief at pages 47-48 and the Brief for Respondent (pp 28-29) criticizes these comments, but bases its criticisms on a misinterpretation of petitioner's argument. The data used by Free in the professed reproductions are given in the record (I, 517). From these, by simple arithmetic, it appears that the "41%" and the "53%" yields claimed by Free were actually respectively about 36% and 40% on

the raw materials he used. A much greater correction, however, is necessary. The Rainer patent clearly states that the peptones and sugar going to make up the nutrient solution shall be in the ratio of two of peptone to one of sugar. Free actually reversed this ratio, making it one of peptone to two of sugar. As pointed out by Lamb, such departure was a flagrant violation of the directions of the patent Free purported to follow.

> "Q. 471. Dr. Free said that he used amounts of peptone and sugar in the fermenter to start in his repeated experiments of 10 and 1, which are his so-called Rainer experiments, a peptone and sugar ratio of 2 to 1, and he added sugar and peptone according to the figures which are on the record, so that considering the total peptone and total sugar over the full-test period, the peptone and sugar ratio was 1 to 2; in other words, the ratio at the start was reversed during the progress of the test. Do you find in the Rainer patent any disclosure of the procedure followed by Dr. Free in this respect?
>
> A. I do not, sir. This patent, which is quite confused in many respects, is clear and definite in all of its indications on the principle that the sugars shall be added at about only one-half the concentration of the peptones. That principle is adhered to throughout where any reference to amounts is made, and Dr. Free departed from this clear and unequivocal teaching of the patent in this respect to a marked degree." (I, 438-9)

Now, therefore, since Free gave us the information that he obtained one unit of peptones from three units of the malt sprouts comprising his raw materials, it is again a matter of simple arithmetic to demonstrate that, if he had truly followed the Rainer disclosure, he would have employed four times the quantity of malt sprouts, which he did employ, and that in figuring the yield of his yeast product he would have necessarily found it to be below 20%. As stated, this conclusion is a simple matter of

arithmetic.* It harmonizes with, and is explained by, Judge Soper's discussion of the reference in 38 F. (2d) 329, 334-35, 338. Of course, it also harmonizes with, and confirms, the characterization in the Kiby Handbook that commercial efforts to make use of the disclosure of the Rainer patent of 1879 were "uniformly unsuccessful".

The evidence discussed above is not commented on in the opinion below of the Circuit Court of Appeals for the Third Circuit. This evidence, however, proves the following crucial statement in that opinion to be in error:

> "We are convinced, however, that there is little difference in substance between beginning fermentation with a wort at 1° Balling and adding nutrient solution at 12° Balling from time to time to prevent the excess production of alcohol as taught by Hayduck** and beginning the fermentative processes with such a low

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* Since Free obtained only ⅓ unit of peptone from each unit of malt sprouts used he would (had he followed Rainer) have had to use 12 units of malt sprouts, i.e. 4 units of peptone, and 4 units of molasses (containing 50% sugar), i.e. 2 units of sugar, to have a peptone to sugar ratio of two to one and to obtain a yeast yield of 2.5 to 3 units of yeast. This would give a yeast yield of $\frac{2.5}{12+4} = 15.6\%$, or $\frac{3}{12+4} = 19\%$ on the raw materials. On page 28 of its Brief respondent questions why petitioner did not offer testimony by its own witnesses, as to Rainer's yield. The answer is that mere arithmetic applied to Free's results made separate evidence unnecessary.

** The Court misstates the Hayduck –105 process by saying that the 12° Balling is added "from time to time". It is added "slowly and substantially continuously" at a rate equal to the consumption by the yeast of the nutrients from the solution, to maintain the concentration of the nutrients "substantially constant" during the period of propagation. This is contrasted with Rainer, who adds lump doses of sugar at uncertain intervals and only when the sugar theretofore in the solution in the vat has been all or mostly all consumed.

concentration of sugar in the nutrient solution that the feeding yeast will not produce excessive alcohol as taught by Rainer * * *." (R. I, 682)

The "difference" between Hayduck's process and Rainer's process was all the difference between success and failure.

It is submitted that respondent's statement that the War in Europe and Prohibition in the United States first made it desirable for the practical art to combine the step of initiating propagation in a highly dilute nutrient solution and the step of substantially continuously feeding in relatively concentrated nutrient solution at a rate to keep the dilution (Balling) in the propagating vat substantially constant, is wholly disproved by the record facts discussed above. It is, therefore, necessary to adopt the contrary conclusion, which, moreover, harmonizes with all the facts, namely, that the failure of the art to combine steps into a unitary process which comprises the Hayduck -105 invention was because either the desirability of that combination or the actual putting together of the steps into that combination, or both, was not obvious and was beyond the capability of the ordinary skilled worker in the art.

The benefits which flowed from the process, after Hayduck invented it, would have flowed from the process if it had been devised during all those thirty-five years prior to Hayduck. The same profit motive obtained during all those years. It would seem that the only conclusion, which alike appeals to common sense and sound law, is that the combination was not "obvious" and that the Hayduck patent -105 is valid.

As to the -106 Patent

Here respondent's argument of obviousness rests altogether on counsel's mere assertion.

There is no denial that the invention of this patent (for example claim 13) covers a unitary process comprising

four steps *in combination*, namely, inorganic ammonium salts as a nitrogen source in the nutrient solution, initiating propagation in a portion of the solution highly diluted, during propagation feeding in the concentrated reserve solution substantially continuously to maintain the nutrient content in the propagating vat substantially constant, and neutralizing the deleterious excess of acidity released from the inorganic salts during propagation.

Respondent's argument is merely the assertion that, the Court below having held the process which includes the sub-combination of a certain two of those steps (i.e., inorganic salts and neutralization) unpatentable, and the discretely different process which comprises the sub-combination of the other two steps (i.e., initiating propagation in a highly dilute portion and feeding concentrated reserve to maintain substantially constant Balling) unpatentable, it must follow (!) that a third process combining all four steps in combination could not be patentable.

There is a fatal flaw in such argument. Respondent cites no reference of the prior art which its witnesses or its counsel even profess to assert as disclosing either the desirability or the practicability of integrally combining all four steps into a unitary process. In the absence of any such reference whatever in the prior art, respondent's mere assertion of "obviousness" is without any tenable basis.

Actually, the Court below rested its adverse holding with respect to patent -106 on its mere holding that patents -103 and -105 were respectively invalid. As pointed out in Petitioner's Main Brief, the validity or invalidity, per se, of patents -103 and -105 is of no significance on the question of the validity of -106. For reasons also there expressed, patents -103 and -105 are not prior art against patent -106 under the heretofore followed doctrine of the various Circuit Courts of Appeals. The reason why they are not prior art against the same inventor (being copending applications), although they might be prior art against a different inventor, appears clearly

from Section 4886 of Revised Statutes, (U. S. C. title 35, § 31), the pertinent portion of which reads:

> "Any person who has invented or discovered * * * any new and useful art, * * * not known or used **by others** in this country, before his invention or discovery thereof, and not patented or described in any printed publication in this or any foreign country, before his invention or discovery thereof or more than two years prior to his application, and not in public use or on sale in this country for more than two years prior to his application, * * * may * * * obtain a patent therefor."

The knowledge of Hayduck as to the –103 and –105 processes was not knowledge "by others". It was not prior art against him, though it might have been against a different inventor.

Actually, moreover, there is no evidence whatever to justify the assumption made by respondent (its Brief, p. 50) that another than Hayduck might not have obtained a valid patent for the four-step combination, assuming it was the newcomer's invention. On the contrary, the entire record supports the presumption of validity of patent –106, irrespective of the patentee's name (as long as he was the true inventor), and supports the conclusion that the four-step combination process was a patentable invention on the part of its originator.

Patents –105 and –106 Are Not Indefinite

The argument of Respondent's Brief (pp. 34-46) needs some reply because it seems to petitioner that the argument purports to rest upon a ground other than that dealt with in the decision of the Circuit Court of Appeals below.

The trial Court held that the disclosure of the patent was not adequate as to the rate of feed of the concentrated reserve wort into the diluted wort during the propagation. This holding was repeated by the Circuit Court of Ap-

peals for the Third Circuit as discussed in Petitioner's Main Brief, pages 50-54.

Respondent's Brief takes the position that the indefiniteness concerns the question of whether the propagation of the yeast is to take place in the solution diluted to about 1° Balling on the one hand, or between 3° to 5° Balling on the other hand.

It is petitioner's position that the propagation occurs in the solution at about 1° Balling and it is respondent's position that the patent directs it to take place in the solution at about 4° Balling.

We submit that the language of the patent clearly supports petitioner's position and as clearly refutes respondent's position. The evidence of the witnesses likewise establishes the correctness of petitioner's position.

The patent states that a relatively concentrated solution is first prepared,

> "A wort adapted for yeast propagation (having, for example a gravity of 12° Balling) is prepared according to the procedure commonly followed in the compressed yeast industry." (R. II, 5, ll. 66-70)

It next specifies that a portion of the solution is placed in the propagating vat and diluted [with water] to about 1° Balling and that propagation of the yeast is then initiated:

> "A part of this wort is placed in the fermenting vat and is highly diluted (for example, to about 1° Balling), yeast is added thereto and it is aerated." (R. II, 5, ll. 70-73)

The patent continues to instruct that the 12° Balling reserve wort is then added slowly and substantially continuously at a rate such that the sugar will be consumed in making yeast and not in making alcohol, and that this means at a rate such that the 1° Balling at which propagation is initiated shall remain substantially constant:

> "Thereupon the remainder of the concentrated wort is added slowly and substantially continuously throughout a protracted period of time and at a rate such that not only the alcohol which may have been formed from the quantity of sugar present in the diluted portion of the wort, but also any alcohol which may be formed from the sugar which is present in the added wort, can be assimilated immediately by the yeast." (R. II, 5, ll. 74-84)

and

> "at a rate such that the concentration of the dilute wort remains substantially constant," (R. II, 5, ll. 45-47)

The witnesses are all in agreement that this objective instruction of the patent can be fulfilled only by initiating propagation in the solution at a dilution of about 1° Balling and feeding in the more concentrated reserve so that the nutrient concentration in which propagation is occurring remains substantially constant at about 1° Balling. Respondent's witness Free conceded this by saying:

> "I agree that about 1 degree Balling is the desirable concentration in the fermenter during the propagating period for efficient utilization of the nutrients toward maximum yeast production and minimum alcohol production, assuming that that 1 degree Balling represents substantially the sugar concentration, percentage of fermentable sugar."* (R. I, 560)

Respondent's Brief proceeds to argue, however, that another statement in the patent is inconsistent with the statements quoted above, and gives a contrary teaching that the propagation shall occur in a solution having a concentration of about 4° Balling. The statement pointed to by respondent, however, deals neither with the rate of feed, nor with the Balling of the solution in which yeast

* This assumption had been earlier conceded correct by respondent's other witness Rautenstrauch. (R. I, 201)

propagation *is occurring.* It deals on the contrary with the quantitative division of the initially prepared 12° Balling into two parts, one part to be diluted to 1° Balling in which propagation is begun and the other part to remain at 12° Balling and to be used as the reserve for feeding in. The sentence in question reads:

> "The quantity of the diluted wort which is originally available for the yeast is so chosen, for example, that the mean content of the entire wort employed would be 3° to 5° Balling." (R. II, 5, ll. 90-95)

Dr. Lamb explains the significance of this instruction, its novelty in the art, and its practical importance at R. I, 63, 65, Qs. 39 and 40.

If the sentence means, as respondent contends, that the concentration of the solution in which propagation is occurring has to be raised from 1° Balling (at which it is explicitly stated to start) to 4° Balling, then that result could be accomplished only by feeding in the 12° Balling reserve at a rate much faster than the nutrients were being consumed by the yeast. This was admitted by Free, as follows:

> "XQ. 415. Starting the propagation in the fermenter with a nutrient solution of 1 degree Balling, can you raise the Balling within the range of 3 to 5 during any substantial part of the propagating process in any other way than feeding in more concentrated yeast nutrients to the fermenter during that period?
>
> A. I don't know—I think it probably cannot." (R. I, 564)

In other words, respondent's position is that the sentence involves the rate of feed of the reserve solution. Respondent's Brief points out in a footnote on page 43 that:

> "Petitioner's counsel during the trial denied that the 3 to 5 language 'concerns the rate of feed during

yeast manufacture', saying that it dealt 'with the preselection in preparation to begin' (R. I, 410), and that 'It has nothing to do with the feeding, with the rate of feeding. It has a great deal to do with the yeast manufacture' (R. I, 412)."

Respondent's Brief, however, disingenuously fails to add that during the trial respondent's counsel conceded that the language in question did not refer to the rate of feed, as follows:

"I agree with Mr. Watson that that sentence has nothing to do with the rate of feed but, if anything, it has to do with the dilution and the quantity. I agree with that." (R. I, 355)

Since, therefore, we have respondent's concession that the sentence in question does not concern the rate of feed, it must be taken as established that the sentence relates to the fractional **division** of the 12° Balling wort into one part (for dilution to 1° Balling to initiate propagation) and the remaining part (to be fed in as concentrated reserve). This being so, there is no inconsistency and no indefiniteness in the patent, either on the point of dividing the 12° Balling into two portions, one for dilution and the other for reserve feed in, or on the point of feeding in the concentrated reserve so that the nutrients are added at the same rate the nutrients are being consumed by the yeast; and the Balling of the solution in the propagating vat consequently remains substantially constant at 1°.

From the foregoing it also appears that the sentence quoted concerns an arithmetical computation, a formula, of great usefulness in yeast manufacture. It does not mean that the 1° Balling of the initial fraction and the 12° reserve are ever physically dumped together to raise the composite Balling to 4°; but only that the relative quantities of the two are so chosen that if they were merely dumped together they would give a 4° Balling.

Respondent's Brief (p. 42) states that Hayduck's "3 to 5 rule" as interpreted by Lamb was purely hypothetical

and of no interest to the yeast manufacturer. Lamb's testimony as to how the yeast manufacturer would avail himself of this rule reads:

> "You do this before any yeast manufacturing begins. You *could* perform a hypothetical experiment, mixing these two, dilute and concentrated solutions, together, and if you obeyed the rule and took the right proportions of those substances, liquids, you will have a mean Balling of 3 to 5. *The yeastmaker does not have to do that because he has a pen and pencil and he can do it in a moment with arithmetical calculation.*" (R. I, 369-70)*

That this formula is of great utility is proved by the evidence which shows that both The Federal Yeast Corporation (R. I, 619) (enjoined in the Maryland litigation) and the respondent (R. I, 86, 91, 97) here, actually conducted their processes in accordance with the formula. The novelty of the formula is established by the complete absence of any prior art which is even asserted to disclose or forecast it.

Respondent's argument of indefiniteness against patent –105 is thus wholly unsound.

While respondent advances the same argument against patent –106 also, it should be pointed out that this patent does not contain the same sentence. This patent clearly states:

> "the seed yeast may be added in the first instance to a solution of a strength of about 1° Balling and containing also a proportionate amount of nutrient salts which are used, and thereafter during the growth of the yeast the solution containing about 10% of sugar and a proportionate quantity of the nutrient

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* An example of how the yeast manufacturer makes his computation in order to know what portion of the reserve wort to dilute was given by petitioner's witness Lamb (R. I, 375; cf. Pltf's. Exh. 19, R. II, 85), and at R. I, 397-98 witness pointed out the reason why the rule is important and the resultant disadvantages if the yeast manufacturer did not follow it.

> salts, may be added slowly and substantially continuously so as to maintain the concentration of the solution in which the yeast is propagating approximately constant or at a slightly greater or less concentration during the main portion of the period of propagation." (R. I, 9, ll. 19-33)

and

> "The rate of addition and the duration of the process may be determined in accordance with tests so that the concentration remains approximately constant * * *." (R. I, 9, ll. 65-68)

The "tests" referred to consist in mere observations of the saccharimeter (the common instrument for Balling measurement), so that if the Balling tends to decrease then the rate of more concentrated feed is increased, and if the Balling tends to increase then the rate of feed is decreased, so that in either case the constancy of Balling is maintained in the propagating solution.

Respondent's Brief now disputes that simple observations of the saccharimeter would be sufficient. Under the heading, "The use of a density gauge does not save the patent." It says:

> "The gauge measures the total amount of solids in the wort, including seed yeast, propagated yeast, grain materials, molasses materials, salts, etc., and does not measure the amount of sugar in the wort, as pointed out by respondent's witnesses, without contradiction." (p. 45)

Turning to the record, however, we find respondent's witness Rautenstrauch answering questions of the trial Court, as follows:

> "The Witness (aside to the Court): You have clearly in mind, your Honor, that degree Balling refers to the sugar content?
>
> The Court: Well, not entirely to sugar, does it, Doctor?
>
> The Witness: Generally.

The Court: It is just a measurement of the sugar content, is it?

The Witness: Yes, generally.

The Court: In other words, the Balling scale is the sugar scale, is it?

The Witness: Generally. If it is an entire sugar solution, then it is absolute. Where the sugar predominates, it approximates. So that when you refer to the Balling of the mash, you are interested in that reference to the amount of sugar. It shows it relatively." (R. I, 200-201)

Petitioner's witness, Lamb, testified to the same effect in the language already quoted.

The technical correctness of, and the record support for, the matter on pages 50 to 54 inclusive of Petitioner's Main Brief are both thus wholly substantiated.

Miscellaneous

Respondent's Brief stoops to certain arguments which either have no proper bearing on the ultimate issues involved or which are without record support.

1. For example, it states (p. 3) that the acid constituents of both the inorganic ammonium salts (ammonium phosphate and ammonium sulphate) are utilized by the yeast, and implies that no acidity problem arises from the use of these salts. This is entirely contrary to the proved facts in this and the prior Maryland litigations. On page 5 Respondent's Brief states that respondent "independently developed its own processes * * * The equities of the case are strongly against petitioner". Neither statement has any record support whatever. Respondent carefully kept off the stand any witness having first hand knowledge of respondent's processes and their development. What those processes are is relevant in this case only to the question of infringement, an issue not now before this Court. We feel we should add, however, that respondent's processes closely parallel those

of the defendant in the Maryland litigation held to infringe, (cf. footnote 38 F. (2d) 338) and that respondent is merely the usual deliberate infringer.

2. On pages 16 and 17, Respondent's Brief draws the conclusion from its processes that inorganic salts may be useful without neutralization. But whether those processes included neutralization is a question of infringement, and that question is not now before this Court. Petitioner is wholly prepared in the proper forum to establish its case of infringement and to prove that neutralization is employed in each of respondent's processes.

3. On page 21, Respondent's Brief asserts that the District Court in the Maryland litigation held patent 103 valid on the mere ground that it taught the use of the process for large scale commercial production instead of for laboratory procedure. A reading of the Maryland decision (8 F. (2d) 186) and of the decision of the Circuit Court of Appeals for the Fourth Circuit (13 F. (2d) 570) shows that respondent's statement is most unfair and incorrect.

4. Respondent's Brief makes short reference (pp. 30 and 33) to the article of Delbruck (R. II, 174) and the prior foreign patent of Kamienski (R. II, 142). Neither of these was referred to by the opinion of the Circuit Court of Appeals below and their non-anticipatory nature is clearly pointed out in the prior decision of Judge Soper (38 F. (2d) 329, 335 and 337).

5. On pages 42-44 Respondent's Brief asperses petitioner's expert witness, Arthur B. Lamb. Lamb is professor of chemistry at Harvard University and Director of the Chemical Laboratory at that institution. He is past president of the American Chemical Society and a member of the American Academy of Arts and Sciences, the Washington Academy of Sciences and of the National Academy of Arts and Sciences (R. I, 52). He appeared as petitioner's witness in the former Maryland litigations

and has been intimately familiar with the subject matter for many years.

Respondent's witnesses were Rautenstrauch and Free. Rautenstrauch teaches Industrial Engineering at Columbia University. He was brought into the case below only a week before the trial (R. I, 194). Prior to his industrial engineering course, he taught mechanical engineering. He is not a chemical engineer. He had been a consultant with the J. G. White Management Corporation, he was in the real estate business with the Fred F. French Company, and for a time with the Splitdorf Electrical Company (R. I, 242-243). His knowledge of yeast manufacture was acquired from 1923 to 1926 while in a mere managerial relation with the Liberty Yeast Corporation. In preparing for his testimony, he "did not read the opinions of the District Court and the Court of Appeals for the Fourth Circuit in the cases against the Federal Yeast Corporation" (R. I, 195).

Free stated:

> "I do not pretend to be a practical yeast maker and I have no intention of testifying concerning the practical manufacture of yeast in any way" (R. I, 270-271).

He also had not read the opinions of the Courts in the Maryland litigation (R. I, 551) before testifying.

6. An inspection of the opinions of this Court cited in Respondent's Brief makes adequately clear the reasons why none is inconsistent with holdings of validity of the three patents now before the Court. Lest the Court be led into error by the unsound textbook statement in Respondent's Brief (p. 50) from Walker on Patents; Deller Edition, p. 1275;

> ' where a patent contains two claims which are alike, except that the narrower one of them calls for an unpatentable addition to what is called for by the other, the narrower claim is void"

it should be pointed out that the author rests it on the citation of three earlier cases, the first of which was reversed on a point which destroyed the trial Court's conclusion (*Featherstone* v. *George R. Bidwell Cycle Co.*, 57 Fed. 631); the second of which held invalid a claim differing only by including set screws (*Packard* v. *Lacing Stud Co.*, 70 Fed. 66, 68); and the third of which was reversed on the very point involved (*Consolidated Car-Heating Co.* v. *West End St. Ry. Co.*, 85 Fed. 662).

Conclusion

It is submitted that the three Hayduck patents should be held valid.

Respectfully submitted,

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CLAIR V. JOHNSON,
Counsel for Petitioner.

IN THE

Supreme Court of the United States

OCTOBER TERM—1938.

No. 701

STANDARD BRANDS INCORPORATED,

Petitioner,

vs.

NATIONAL GRAIN YEAST CORPORATION,

Respondent.

BRIEF FOR RESPONDENT IN ANSWER TO PETITION FOR WRIT OF CERTIORARI.

STEPHEN H. PHILBIN,
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Counsel for Respondent.

March, 1939.

Law Printing Company, Inc., 80 Lafayette Street, New York, N. Y.

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STANDARD BRANDS INCORPORATED,
Petitioner,
vs.
NATIONAL GRAIN YEAST CORPORATION,
Respondent.

BRIEF FOR RESPONDENT IN ANSWER TO PETITION FOR WRIT OF CERTIORARI.

This is an ordinary patent case. The five patents in suit were held invalid by the Circuit Court of Appeals for the Third Circuit. No licenses have been taken under the patents. The only persons interested in the suit are the two parties. There is no question of jurisprudence or other question of special, important or general interest.

The patents are four Hayduck patents, 1,449,103, 1,449,105, 1,449,106 and 1,449,109 and a Corby *et al.* patent 1,673,735. Each of the Hayduck patents was applied for on October 30, 1920 and issued on March 20, 1923, and they will be referred to as the 103, 105, etc. patents. The Corby patent was filed August 16, 1924 and issued June 12, 1928.

In the present case, the District Court for New Jersey held that the 103 patent was valid and was infringed by one process but not by two other processes of respondent, and that the other four patents were invalid, there being no decision on the issues of infringement of the last four patents (1 Rec. 626; 21 F. Supp. 46). The Circuit Court of Appeals for the Third Circuit decided that all five patents were invalid, and it did not pass upon any issue of infringement (1 Rec. 668; no Federal Reporter citation).

The only question decided by two Circuit Courts of Appeals was as to the validity of patent 1,449,103.

1. The 103 patent, in *Federal Yeast Corporation* v. *Fleischmann Co.*, 13 F. (2d) 570, was held valid by the Circuit Court of Appeals for the Fourth Circuit, against the same defense, of invalidity over the prior art, as in the present case. That Court did not decide any issue of infringement, because infringement had been admitted in the District Court, as stated in the latter's opinion, 8 F. (2d) 186, 200. Neither did the Circuit Court of Appeals for the Third Circuit decide any question of infringement (1 Rec. 668). So the only conflict is with respect to the validity of the 103 patent.

But a mere conflict between Circuit Courts of Appeals does not mean that this Court, in the exercise of its sound judicial discretion, must grant certiorari. The conflict must be "embarrassing", as declared in *Layne & Bowler Corp.* v. *Western Well Works*, 261 U. S. 387, 393, where this Court said: "it is very important that we be consistent in not granting the writ of certiorari except in cases involving principles the settlement of which is of importance to the public as distinguished from that of the parties, and in cases where there is a real and embarrassing conflict of opinion and authority between the circuit courts of appeals." In the present case the 103 patent expires in March of next year, there are no licensees, the patent has been

held invalid and no public interest is affected by the conflict.

However, if a writ of certiorari should be granted with respect to the 103 patent, such review should be limited to the question of its validity, because that is the only question warranting consideration in the interest of uniformity of decisions between Circuit Courts of Appeals. Such limitation would be proper practice: "Not only does the Court confine review to cases involving questions warranting consideration in the interests of jurisprudence and uniformity of decision, but to the particular questions in those cases which are deemed to be of that nature", *Robertson & Kirkham, Jurisdiction of the Supreme Court*, p. 557.

2. The 105 and 106 patents, in *Standard Brands Inc.* v. *Federal Yeast Corp.*, 38 F. (2d) 329, were held valid by the District Court for Maryland on a different record and against a different defense than in the present case.* Upon defendant appealing in that case, the plaintiff made a settlement with defendant, which agreed to withdraw its appeal, thus preventing a decision by the Circuit Court of Appeals.

Respondent opposes the petition for writ of certiorari with respect to these two patents, on the ground that "a conflict between decisions of the Circuit Courts of Appeals and decisions of District Courts in other circuits is entirely outside the rule which moves the Supreme Court to grant the writ solely on the ground of a conflict of decisions" (*Robertson & Kirkham, Jurisdiction of the Supreme Court*, p. 577), and also on the additional ground that there was no real conflict, the courts in this case sustaining the defense of indefiniteness, which was not presented to or passed upon by the Maryland District Court, there being "differences between the record here and the record in the Maryland court" (District Court opinion, 1 Rec. 634).

There is no question of jurisprudence or other question

---

*The records in the Federal Yeast suits are defendant's exhibit D-11.

of public importance or interest in respect to these patents. They expire in March of next year, there are no licensees under them, the controversies regarding the validity and scope of their claims are of only private interest, and there is no special or important reason why petitioner should be allowed to continue litigating these patents against respondent.

3. The 109 patent and the Corby patent have been adjudicated only in the present case, the courts agreeing that these patents were invalid.

Respondent opposes the petition with respect to these patents, on the ground that there is no conflict of decisions or question of public importance or interest. The petition for writ of certiorari states that it "is not based" on these patents (petit., p. 2, footnote), the patents are not mentioned in petitioner's "Reasons Relied Upon for the Grant of the Writ of Certiorari" (pp. 3, 4) or "Argument" (pp. 6, 7, 8), and no reason appears for further litigation in this suit of these patents, which the courts below agreed were invalid.

The subject matter of the suit and prior litigation.

The patents relate to yeast, particularly yeast used in bread, the petitioner* having been for many years the largest manufacturer and dominant power in the yeast industry, owning many patents.

Yeast is a uni-cellular organism which multiplies by budding, the buds splitting off to form new cells. It grows best in a solution of water and foods which will provide carbon, nitrogen, phosphorus and other materials, such a solution being called a wort or mash. The wort should be slightly acid, in order to obtain the best results. All this was well known prior to the patents in suit.

* For convenience, "petitioner" will mean either the petitioner or its predecessor in the yeast business, The Fleischmann Company.

On October 30, 1920, five different patent applications were filed, resulting in Hayduck patents 102, 103, 105, 106 and 109.

(a). The 102 patent (not in suit) proposed the use of inorganic salts, in a diluted wort, *Standard Brands* v. *Federal Yeast*, 38 F. (2d) 329, 351.

(b). The 103 patent (2 Rec. 1) proposed to neutralize excessive acidity in a wort, due to inorganic salts, in order to prevent the wort from becoming too acid, by adding an antacid (alkaline or basic material). But it was known that inorganic salts, when consumed by the yeast, might release inorganic acids which were harmful to it, and that such acidity could be neutralized by adding antacids (Henneberg and Pure Food articles, 2 Rec. 158, 166; opinion of Third Circuit Court of Appeals, 1 Rec. 674 *et seq.*). This was in effect admitted by the District Court for Maryland, 8 F. (2d) 186, 193, but influenced, we think, by what it said was the "great size" of the Fleischmann business (*id.*, p. 188) and "the commercial success of the patent" (*id.* p. 198), the patent was sustained. The Maryland court declared (p. 198):

> "It is one thing to show that, when yeast is used in fermentation processess, its fermentative power and duration of life will be enhanced by offsetting deleterious acidity or that in producing pure yeast cultures in the laboratory with distilled water, antacid substances should be used, and it is quite another to demonstrate that, when the end in view is the production of large quantities of yeast for its own sake, neutralizers may be advantageously employed."

The Circuit Court of Appeals for the Fourth Circuit affirmed on this opinion, 13 F. (2d) 570. Thus the view in the Fourth Circuit was that the principle of neutralizing excessive acidity in yeast manufacture, known to and described by earlier workers in the field, could be validly patented for commercial use by a later comer. This view was erroneous and the decision in the present case of the Circuit Court of Appeals for the Third Circuit was cor-

rect, being in accordance with views often expressed by this Court that a previously known principle can not be validly patented. That decision cited and followed *Altoona Theatres* v. *American Tri-Ergon*, 294 U. S. 477, 486, *Paramount Publix* v. *American Tri-Ergon*, 294 U. S. 464, 473, and *De Forest Radio Co.* v. *General Electric*, 283 U. S. 664, which were decided by this Court after the decision of the Circuit Court of Appeals for the Fourth Circuit. In the *De Forest* case, a patent on a high vacuum tube was held invalid, although it had great commercial success, because the scientific principle of the tube had been previously known.

(c). The 105 patent (2 Rec. 5) assumes to cover the idea of supplying food to the yeast "at a rate such that the yeast may propagate and substantially all of the alcohol which may be formed is assimilated by the yeast" (typical patent claim 4). It was old to supply some food (peptones) continuously, and to supply other food (sugar) at intervals, in order to keep low the alcohol production and to obtain "high yield in the yeast". This was admitted in the 105 patent (p. 1, ll. 33 to 50), and had been previously disclosed in the Rainier patent (2 Rec. 135), Iwanowski article (2 Rec. 157) and Lafar Handbuch (2 Rec. 178).

The District Court for Maryland declared that the 105 patent was valid, against the defense of invalidity because of the prior art, 38 F. (2d) 329, saying "The commercial success of the process disclosed in the Hayduck patent 105 tends to show its validity" (p. 337). In the present case, there was a showing that commercial success was not attributable to this patent, and, in addition to the defense of prior art (not passed upon by the courts in the present case), there was the substantial, and sustained, defense of invalidity because of indefiniteness.

The patent is indefinite in failing to disclose what is the rate of feeding which would produce much yeast and little alcohol, it being admitted by petitioner's expert witness that the patent was dealing with "a purely hypothetical experiment", describing "* * * a wholly condi-

tional—it is an imaginary situation" (Lamb, 1 R. 369) and by another witness for petitioner that it was impossible to discover what the feeding rate should be except "by a series of experiences" (Feild, 1 Rec. 384). Although petitioner in 1919 acquired rights to the process of this patent, it was not until 1923 that petitioner commenced using it (1 Rec. 595), which delay, if the patented process was as valuable as petitioner asserted, is only explicable because of the necessity of lengthy experiments. The courts below were correct in following the rule declared by this Court that "If the description be so vague and uncertain that no one can tell, except by independent experiments, how to construct the patented device, the patent is void", *The Incandescent Lamp Patent*, 159 U. S. 465, 474.

The claims of this patent are also invalid on their face, because they fail "to make a disclosure sufficiently definite," *General Electric* v. *Wabash Appliance Corp.*, 304 U. S. 364, 368. In that case, this Court said (p. 368) a claim defining a tungsten filament as "made up mainly of a number of comparatively large grains *of such size and contour as to prevent* substantial sagging and offsetting during a normal or commercially useful life for such a lamp or other device" was invalid on its face. The same is true in the present case, where the rate of feeding yeast is defined in the description only as "at a rate such that no large excess of alcohol will be formed, and the yeast can assimilate most of the alcohol that is so formed" (p. 1, l. 60 *et seq.*) and in typical claim 4 as "at a rate such that the yeast may propagate and substantially all of the alcohol which may be formed is assimilated by the yeast."

(d). The 106 patent (2 Rec. 8) proposes to supply the neutralized wort of the 103 patent at the feeding rate of the 105 patent. In the statement of facts agreed to by the parties (1 Rec. 38) the 106 patent is referred to as follows, viz: "The process of this patent is one combining the process of patent 103, including neutralization, and

the process of patent 105, including regulated nutrient feed".

The District Court for Maryland sustained this patent against the defenses that the 103 and 105 patents were prior art and of double patenting, 38 F. (2d) 329, 343. These defenses were obviously unsound. All the patents were applied for on the same day and they issued on the same day, so none was prior to the others. And the claims of each patent were different from those of any other, so there was no double patenting. The substantial defenses were those presented in the present case, viz:

> "The real defense to the validity of the patent, in addition to that of indefiniteness, is that, whatever patentable invention there may have been was exhausted by the neutralization patent [103] and by the feeding patent [105], and it did not rise to the dignity of inventive genius to use the two together." (Defendant's brief, CCA 3, p. 57.)

The defense against the 106 patent of indefiniteness was not passed upon by the courts below, although the 106 patent was as indefinite as the 105 patent with respect to the rate of feeding. The other defense was sustained by both courts, the Circuit Court of Appeals finding that "combining the processes of invalid process patents cannot result in validity" (1 Rec. 684). This was correct, because no patentable genius was required to combine the old process of neutralization with the old and non-inventive process of supplying nutrients, as needed, to the yeast.

Petitioner attempts, as it did in the courts below, to argue that the patents were not prior to each other and that there was no double patenting, citing authorities in support of such propositions (petition, p. 8). But this is merely a red herring, there never having been in the present case any such contention by respondent, its defense on the issue of validity being as above quoted.

(e). The 109 patent (2 Rec. 12) is the same as the 106 patent, except that one of the neutralizing agents described but not claimed in the 103 patent, is claimed in the 109

patent (petitioner's witness Lamb, 1 Rec. 68; agreed statement of facts, 1 Rec. 38). This patent has been litigated only in the Third Circuit.

The specific material proposed for neutralizing was old and well known as a neutralizer in yeast worts, prior to Hayduck, as stated by the Circuit Court of Appeals (1 Rec. 684), and the patent was rightly found invalid for want of patentable invention.

These Hayduck patents are an excellent example of abuse of the patent system, by obtaining a series of patents on trifling variations. The Fleischmann Company filed five applications for Hayduck patents, on the same day, probably with the intention and certainly with the result of securing a large number of patents with which it could embarrass and intimidate competitors. There is not the slightest reason why only one application, and not five, could not have been filed, containing the description of the 109 patent, because it contains practically everything that is in the 102 patent (not in suit), 103, 105 and 106 patents. Instead, the Fleischmann Company filed, on the same day, one application for use of inorganic salts in a diluted wort (102 patent), another application for inorganic salts with neutralization (103 patent), another for rate of feeding (105 patent), another for neutralization and rate of feeding (106 patent), and still another for neutralization, with a particular kind of neutralizer (described in the 103 patent) and rate of feeding (109 patent).

In the absence of conflicting Circuit Court of Appeals decisions there is no justification for further litigation in respect to these trifling variations.

(f). The Corby patent assumes to cover the idea of periodically withdrawing some of the yeast from the fermenting vat, as it grows and multiplies, and renewing the food supplies. This idea was disclosed in the Rainier (2 Rec. 135) and Jacquemin (2 Rec. 127) patents. Also the idea did not rise to the dignity of a patentable invention, as the courts below found.

The commercial success of petitioner was not shown to have been due to the three Hayduck patents, 103, 105 and 106.

Referring to the Hayduck patents 103, 105 and 106, the petition states (p. 2) "The reported decisions on these three Hayduck patents pay tribute to the demonstrated commercial success and industrial importance of these inventions which revolutionized the yeast manufacturing industry". It was upon the broad and benevolent ground of "commercial success" that the patents were sustained in the Fourth Circuit. But the record in the present case shows by petitioner's own sworn statements that the large sales and undoubted commercial success of petitioner can not be fairly attributed to the three patents in question.

In 1924, petitioner sued a competitor, Liberty Yeast Corporation, on ten yeast patents, including the 103, 105 and 106 patents. The verified bill of complaint alleged that petitioner had used in its manufacture each of the ten patents "conjointly" and "profitably" (1 Rec. 593). Thus if petitioner were then truthful, at least seven other patents contributed to the success of its yeast business. The suit was never tried, because petitioner purchased its competitor for $4,000,000 (1 Rec. 250).

In 1924 and 1925, petitioner sued another competitor, Federal Yeast Corporation, on seven of the patents in the *Liberty* suit, including the 103, 105 and 106 patents. Again the verified bills of complaint alleged that each of the several patents in suit had been "conjointly" and "profitably" used in petitioner's manufacture of yeast (deft's ex. D-11).

In the present case, the suit was brought on nine yeast patents, including three which were not in the other suits. The verified bill of complaint (1 Rec. 13) alleged that all the patents had been profitably used by petitioner. (Petitioner's brief (p. 30) in the District Court admitted that the Corby patent "has not been used commercially by plaintiff").

Thus there have been thirteen patents upon which petitioner has brought suit against its competitors, in each case declaring under oath that the commercial success of its great yeast business was due to all the patents in suit. For convenience, the following is a list of these patents, the L, F and N indicating respectively the defendants in the Liberty suit, the Federal suit and the present suit.

L			Pollak	1,123,920
L	F		Hayduck	1,449,102
L	F	N	Hayduck	1,449,103
L	F	N	Hayduck	1,449,105
L	F	N	Hayduck	1,449,106
		N	Hayduck	1,449,109
L	F	N	Nilsson, *et al.*	1,449,127
L	F	N	Wohl	1,449,134
L	F	N	Wohl	1,475,215
L			Corby	1,475,471
L			Kohman	1,475,494
		N	Corby, *et al.*	1,673,735
		N	Ransohoff	1,688,831

It is apparent from the foregoing that, if petitioner is to be believed, its commercial success can not be attributed to only the Hayduck 103, 105 and 106 patents. And, of course, commercial success can be considered "only when invention is in doubt", *De Forest Radio* v. *General Electric*, 283 U. S. 664, 685.

The fact is that the petitioner, although for many years the largest manufacturer of yeast, has itself contributed nothing to the practical development of the art. None of the above thirteen patents resulted from any work by petitioner or its employees, all being bought from others. On the other hand, respondent's processes are its own independent developments. There is no pretense that respondent has copied any of petitioner's processes, and the case for petitioner must depend upon technical questions of the validity and infringement of patents which were developed by others. No licenses have been taken under the patents and there is no special or important reason, of general

public interest, to warrant the further litigation of the patents against respondent.

Conclusion.

The petition for writ of certiorari should be denied, but, if granted, it should be only with respect to the single question of the validity of the Hayduck patent 1,449,103, the only question as to which there is a conflict between Circuit Courts of Appeals.

Respectfully submitted,

STEPHEN H. PHILBIN,
PAUL R. AMES,
Counsel for Respondent.

March, 1939.

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IN THE

Supreme Court of the United States

OCTOBER TERM—1939.

No. 9.

STANDARD BRANDS, INCORPORATED,
Petitioner,

vs.

NATIONAL GRAIN YEAST CORPORATION,
Respondent.

BRIEF FOR RESPONDENT

STEPHEN H. PHILBIN,
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Counsel for Respondent.

October, 1939.

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Respondent.

BRIEF FOR RESPONDENT

OPINIONS BELOW

The opinion below of the Circuit Court of Appeals for the Third Circuit, finding invalid the three Hayduck patents 1,449,103, 1,449,105 and 1,449,106 (hereinafter referred to as the 103, 105 and 106 patents), is reported in 101 F. (2d) 814 and is in this record (1 R. 668).

The opinion below of the district court for New Jersey, finding the 103 patent valid, and the other two patents invalid, is reported in 21 F. Supp. 46 and is in this record (1 R. 626).

The opinion of the district court for Maryland, finding valid the 103 patent, is reported, *Fleischmann Yeast Co.* v. *Federal Yeast Corp.*, 8 F. (2d) 186. The affirming opinion of the Circuit Court of Appeals for the Fourth Circuit is reported in 13 F. (2d) 570, *sub nom. Federal Yeast Corp.* v. *Fleischmann Yeast Co.*

The opinion of the district court for Maryland, finding valid the 105 and 106 patents, is reported, *Standard Brands** v. *Federal Yeast Corp.*, 38 F. (2d) 329.

JURISDICTION

This case is here on a writ of certiorari, granted 306 U. S. 627, to the Circuit Court of Appeals for the Third Circuit, under Section 240(a) of the Judicial Code, 28 U S. C. A. § 347.

QUESTIONS PRESENTED

The grant of the writ of certiorari was "limited to the question of the validity of Hayduck Patents Nos. 1,449,103; 1,449,105; and 1,449,106" (grant, 2 R. 225, 306 U. S. 627).

STATEMENT OF THE CASE

The patents relate to yeast and purport to cover certain methods used in yeast manufacture. The case, however, is not difficult technically and the controlling facts are undisputed.

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*Petitioner succeeded to the business of the Fleischmann Company and, for convenience, "petitioner" will mean either concern.

(1) Yeast "manufacture".

As appears from the Agreed Statement of Facts (1 R. 34), yeast is a living, unicellular, organism which multiplies by a budding process, the buds being split off to form new yeast cells. It is "manufactured" by encouraging its growth and multiplication.

Yeast requires nutrients, which are supplied to it by a solution of foods in water, called a mash or wort.

The nutrients must supply the yeast with carbon and nitrogen material, and also certain mineral substances, particularly phosphorus and sulphur. All these materials are found in grains and in molasses. However, the requisite nitrogen, as well as mineral material, can also be supplied by an ammonium salt, such as ammonium phosphate or ammonium sulphate.

A salt is the combination of an alkaline (antacid) material with an acid material. In the case of the salt ammonium phosphate, ammonia, a nitrogenous compound, has been combined with phosphoric acid. The salt is decomposed by the action of the yeast upon it, the salt being resolved into ammonia materials and phosphoric acid materials, which are then consumed by the yeast as required. Similarly, with respect to ammonium sulphate.

The yeast nutrients, such as grain materials, molasses, salts, etc., usually are from a fraction of a per cent to about twenty per cent of the wort content, the remainder being water. The thickness, or concentration, of the solution depends upon the kinds of nutrients employed, the nature and amount of the seed yeast which is employed to commence the propagation, etc., etc.

The yeast best grows and propagates in a wort which is slightly acid. The degree of acidity will tend to change

during the propagation, because as the yeast consumes the nutrients, both acid and alkaline (antacid) materials will be set free, in varying amounts and at different times, depending upon the kinds, amounts and proportions of the nutrients, the growth and propagation of the yeast, etc., and the yeast will consume them, partially or wholly, depending upon the amount of yeast cells present and their development. Thus the acidity of the wort varies as the yeast grows and multiplies.

The three patents in question purport to describe certain inventions in the manufacture of yeast. Generally, the 103 patent proposes to neutralize deleterious acidity in a wort containing inorganic ammonium salts, by adding an antacid material; the 105 patent suggests adding the nutrients during the growth of the yeast "at a rate such that the yeast may propagate and substantially all of the alcohol which may be formed is assimilated by the yeast" (claim 4 of 105 patent); and the 106 patent combines the neutralization idea of the 103 patent with the "rate of feed" idea of the 105 patent.

(2) The parties.

Petitioner has long been the largest manufacturer of yeast in the United States and is the owner of numerous patents relating to yeast processes upon which it has sued its competitors. The three patents here in question were among the ten patents in the patent suit filed by petitioner in 1924 against Liberty Yeast Corporation, purchased by petitioner before that suit was tried (1 R. 250, 593), and among the seven patents in the patent suits filed by petitioner in 1924 and 1925 against Federal Yeast Corpora-

tion (resp.'s ex. D-11). The present suit was brought on nine yeast patents (bill of complaint, 1 R. 13), four being abandoned prior to trial.

Petitioner asserted in the verified bills of complaint in each of these suits that each of the patents, totalling thirteen, had been "profitably used" in petitioner's manufacture of yeast. As there was no evidence apportioning among the various patents credit for the undoubtedly very large sales by petitioner, there can be no serious or well-founded contention that such sales were due to one or more of the three patents in question.

Petitioner itself does not appear to have contributed anything to advances in the yeast industry. Apparently all the thirteen patents upon which it has been suing were purchased from outsiders, except perhaps the Corby *et al.* patent No. 1,673,735, as to which there is no evidence it has ever been used, petitioner's briefs in the district court below admitting that it "has not been used commercially by plaintiff" (main brief, p. 30), and that petitioner "does not itself commercially practice the Corby invention" (reply brief, pp. 27, 28).

Respondent is a comparatively small yeast manufacturer, which independently developed its own processes, using grains, ammonium lactate and di-ammonium phosphate, as yeast foods. None of these materials is used in petitioner's processes, or described in any of the patents in suit.

The equities of the case are strongly against petitioner.

SUMMARY OF ARGUMENT

The three patents should be declared invalid and the decision of the Circuit Court of Appeals for the Third Circuit affirmed, for the following reasons, viz.:

1. The Hayduck patent 1,449,103 is invalid, for want of invention.

The patent claims the idea of neutralizing a particular kind of acidity, namely, acidity from yeast nourishing (ammonium) inorganic salts. But the prior art knew that a yeast wort should be maintained slightly acid, that inorganic ammonium salts were useful as yeast nutrients, that such salts might produce undesirable acidity, and that such acidity could be neutralized by the addition of an antacid material. Such knowledge anticipated the patent.

2. The Hayduck patent 1,449,105 is invalid, for want of invention and for indefiniteness.

The patent claims the idea of supplying the yeast with nutrients (nature and proportions unstated) at a rate such that much yeast and little alcohol will be produced. But the prior art knew that alcohol might be produced from sugar in the wort, that dilution of the wort would reduce the concentration of sugar (and hence the amount of alcohol produced); and that the low concentration desired for yeast propagation could be obtained by continuously feeding the nutrients to the yeast. The patent is invalid for that reason.

Patent claims for such a rate of feeding that much yeast and little alcohol would be produced, or that the concentration of the dilute wort remains constant, are void, for indefiniteness.

3. The Hayduck patent 1,449,106 is invalid, because it is merely for the use together of the neutralization idea of the 103 patent and the rate of feeding idea of the 105 patent. There was no invention in proposing such combined use.

There is the same defect of indefiniteness, as to rate of feeding, which is found in the 105 patent.

I. HAYDUCK PATENT 1,449,103 IS INVALID, FOR LACK OF PATENTABLE INVENTION.

Hayduck patent 1,449,103 issued March 20, 1923 upon application filed October 30, 1920. Claims 1 to 4 and 7 to 15, both inclusive, were found invalid in the present case, by the Circuit Court of Appeals for the Third Circuit, while the same claims, except 9, 10 and 11, were found valid in the Fourth Circuit. There is no material difference between the claims, for present purposes, the gist of the patent being the idea of neutralizing, in yeast manufacture, harmful acidity from inorganic salts.

A. The alleged invention is the neutralization of harmful acidity from inorganic salts.

Salts are composed of alkaline (antacid) materials and acid materials, and may be decomposed into alkaline parts and acid parts. Sulphur and phosphorus are inorganic, and, therefore, the salts, ammonium sulphate and ammonium phosphate, are inorganic salts. These salts are also termed ammonium salts, mineral salts, and yeast nourishing salts. The ammonium provides nitrogenous sustenance for the yeast and the sulphuric or phosphoric materials provide sulphur or phosphorus.

The Hayduck 103 patent states (p. 1, ll. 16-22; 2 R. 1):

> "An object of this invention is to provide a procedure for the manufacture of yeast on *a large scale commercially,** there being added to the nutrient solution which contains sugar material and yeast nourishing inorganic salts a neutralizing agent for neutralizing the deleterious excess of acidity."

*Italics ours unless otherwise stated.

Two parts of this statement are important. First, that the invention is for "the manufacture of yeast on a large scale commercially", instead of broadly, for any manufacture. This limitation was added by amendment of the Hayduck application during prosecution in the Patent Office (amendment filed Jan. 6, 1923), after discussion by the Patent Office of neutralization disclosures in patents and publications, particularly in the Pollak Swiss patent and a Henneberg article (Patent Office history of the 103 patent, petitioner's ex., P-6). The Patent Office then issued the patent. It may be observed that the district court in Maryland sustained the patent on the ground that petitioner was the first to use the process on a large scale commercially, and not upon the ground that the process was first known by Hayduck (*infra*, p. 20).

The second point to notice is that the alleged invention is limited to neutralization, during propagation of the yeast, of acidity from "yeast nourishing inorganic salts", instead of being broadly for neutralization of acidity from any source. This limitation was in the application as filed, undoubtedly because it was common practice in the yeast industry to neutralize acidity arising from other causes, the Hayduck patent itself stating (p. 2, l. 61, *et seq.*):

> "It is also known that an addition of basic or antacid substances to some fermenting liquids stimulates the fermentation, the injurious action of the acids on the life of the yeast being inhibited."

This is a clear admission that the yeast industry knew that it was desirable to neutralize excessive deleterious acidity whenever it might injure the yeast.

Claim 1 of the Hayduck patent is typical, being cited as such in petitioner's brief (p. 4). It is as follows:

"1. The process of manufacturing yeast which comprises preparing a yeast nutrient solution and propagating yeast therein with aeration, said yeast nutrient solution containing essentially sugar material and *yeast nourishing inorganic salts* from which components are liberated which tend increasingly to acidify the nutrient solution during propagation, and during the period of propagation *neutralizing the deleterious excess of such acidity.*"

Aeration was common practice prior to Hayduck, as appears from Jacquemin British patent 21,011 (p. 1, l. 30, 2 R. 127); Rainer German Patent 10135 (2 R. 135) and Kamienski German patent 269,192 (2 R. 142).

It is entirely clear that the only claim for patentable invention rests upon the very narrow idea that it might be advantageous to neutralize excessive acidity arising from a particular source, namely, inorganic salts. As will appear, Hayduck was not the first to know that inorganic salts might produce acidity which, if deleterious, might be advantageously neutralized.

B. It was known that a yeast wort should be maintained slightly acid.

The yeast industry knew, long prior to Hayduck, that the wort should be maintained slightly acid, in order to obtain the best results, Wilfert article, Presshefe, etc., 1890, (translation, 2 R. 172, two lines from bottom), "The yeast plant requires for its vigorous gro[illegible]h a liquid which is slightly acid"; Molhant, Brit. Pat. [illegible]617 of 1913 (p. 1, l. 29, 2 R. 133), the wort should be [illegible]nly slightly acid"; and American Distillers' Rev., 1914 (sec. col., 2 R. 161), "the distiller or yeast manufacturer should from time to time

make a special test to ascertain the most favorable degree of acidity for the raw materials he is using."

C. It was known that it was advantageous to neutralize excessive acidity.

It would seem obvious, if it were known that a solution should be maintained slightly acid, by testing during operation (this was known, as appears above), to add an antacid, if it were too acid. However, it is unnecessary to speculate whether the skilled yeast chemist knew enough to neutralize excessive acidity, because it plainly appears that neutralizing excessive acidity, by adding antacid materials, was old, in yeast manufacture.

(1) *Pollak neutralized lactic acid, in one step of yeast manufacture, namely, grain souring.*

When grains are employed as yeast nutrients, the grains are soured by the action of lactic acid bacteria in a souring tank, before being placed in the nearby propagation tank (Rautenstrauch, 1 R. 167). This is described in the Pollak Swiss patent 63,539 (transl., 2 R. 152) which corresponds to the Pollak United States patent, 1,123,920, one of the yeast patents upon which petitioner brought suit against the Liberty Yeast Corporation (1 R. 593) and to which petitioner was then attributing its so-called commercial success.

The Swiss Pollak patent commences as follows (2 R. 151):

> "In a plurality of processes of the fermenting industry a *natural acidification* is produced in the fermenting substrate, for example, in the mash in

order to increase the fitness of the liquid, for example, for the subsequent alcoholic fermentation by means of yeast. The acid formation, however, stops at a degree of acidity dependent upon the temperature and the kind of acid bacterium. If it be desired to push this formation of acid further and also to impart greater intensity to the physiological processes taking place at the same time, *the already existing acid concentration which interferes with the fermentation, must be reduced by neutralizing* by means of an alkali."

The "physiological processes" are the growth and action of the micro-organisms, which sour the grain, preliminary to the growth and action of the yeast micro-organisms. As described in the Pollak patent, "When the acid formation has reached a maximum" (so that the growth of the micro-organisms, and hence increase in acidity, is stopped), the amount of neutralization required for the mash is ascertained

"and to the latter [mash] is thereupon added so much ammonia that the amount thereof is sufficient for *neutralizing* ½-¾ of the amount of acid present. In this partly neutralized mash the acid-forming bacterium continues its work until the maximum of acid that can be attained thereby is attained once more. Thereafter the process of neutralization is repeated a number of times until even the increasing salt concentration causes the fermentation process to come to a stop. In this manner however, the formation of acid can be pushed to the quadruple of the former degree of acidity" (2 R. 153).

This is a complete disclosure of the desirability in yeast manufacture of neutralizing excessive acidity, by means of

adding antacid (alkaline, basic) materials, so that there will be "greater intensity to the physiological processes taking place". Referring to this Pollak process, the Hayduck patent admits (p. 2, l. 51, *et seq.*):

> "It is known that there can be added to mashes in lactic fermentation, nitrogen-supplying antacid substances, as for instance ammonia, ammonium carbonate or ammonium carbamate, for the partial *neutralization* of the lactic acid progressively formed and for the augmentation of the yeast-assimilable nitrogen content of the mashes so that they may be utilized for subsequent yeast propagation."

It is true that the above neutralization is not in the fermenting tank, where the yeast propagates, but instead is in the souring tank, in the immediately prior process of grain souring. But the principle is precisely the same. It seems absurd to contend that the workman who was operating souring tanks and fermenting tanks in continuous operation, watching carefully their respective acidities and neutralizing excessive acidity in the souring tanks, by adding ammonia, would not similarly neutralize deleterious acidity in the fermenting tanks, if it should occur.

Petitioner's brief (pp. 32, 33) discusses the Pollak patent and says (p. 33):

> "Pollak's object was practically the antithesis of Hayduck's. Pollak sought to make more sugar into an organic acid to form larger amounts of the organic ammonium salt, all *prior* to yeast propagation —Hayduck used the sugar plus inorganic ammonium salts to make yeast, and neutralized the deleterious excess of resulting acidity released *during* the propagation" (emphasis petitioner's).

Pollak grew souring bacteria, producing lactic acid to form the salt, ammonium lactate, and he removed excess free acid, by adding an antacid (ammonia) as required, because such excess was injurious to the souring bacteria. Hayduck proposes the same neutralization process, namely, to remove excess free acid, by adding an antacid (calcium carbonate, ammonium carbonate) as required, because such excess injured the yeast. It is true that the lactic acid neutralized by Pollak is not as strong as inorganic acids such as the sulphuric acid, neutralized by Hayduck, but this does not aid petitioner, as it would be even more natural to protect against excessive sulphuric acid than against excessive lactic acid.

The principle of neutralization of undesired acidity in yeast manufacture being thus disclosed in the Pollak patent, even if there were no other disclosure in the prior art, the Hayduck patent should be declared invalid. But there is additional prior art.

(2) *Wilfert neutralized sulphuric acid, in a similar step of yeast manufacture.*

The excerpt from the Wilfert article (Presshefe, etc., 2 R. 171) discloses that some sulphuric acid is beneficial to yeast development, but that excessive sulphuric acid is harmful, and that, if present in such amounts as to be deleterious, its harmful effect may be prevented, either by diluting the wort or by neutralizing it. In referring to a wort (mash) containing grains and sulphuric acid, Wilfert states (2 R. 172):

> "The sulphuric acid acts disadvantageously on the development of the yeast only when it is present in large amounts; conversely, a small amount of sul-

> phuric acid is highly beneficial for the development of the yeast, as it contributes considerably to the production of a very pure and vigorous yeast. The yeast plant requires for its vigorous growth a liquid which is slightly acid; * * *."

Wilfert proposes to reduce deleterious acidity, by using a greatly diluted mash, saying (2 R. 173):

> "In a mash in which the sulphuric acid content is diluted to that extent, the development of the yeast and the fermentation proceed in a perfectly normal way and there is no reason to be found for removing the sulphuric acid from the liquor."

However, if, after dilution, such removal should be desired, Wilfert says (2 R. 173):

> "This can be done in a very simple way by adding to the mash slaked lime—stirred up in water to give a milky fluid—until the acid taste of the mash is scarcely discernible any longer."

Lime (calcium compound) is an antacid, and the Hayduck 103 patent prefers to use a calcium compound as the neutralizing antacid (calcium carbonate, pat., p. 1, ll. 66, 87, 2 R. 1). Thus Wilfert cures an excess of sulphuric acid, which is harmful to the yeast in the fermentation process, by the "very simple" expedient of neutralizing precisely as Hayduck later proposed to do, dealing with the same acid (103 pat., p. 1, l. 85 *et seq.*).

With the materials and process described by Wilfert, the addition of neutralizing materials to the diluted original mash, was not necessary (2 R. 174):

> "As one can convince himself by a comparative test with two lots of the same mash, one of which

> was *neutralized* with lime whereas the other was left in the original state, the *neutralization* has not the slightest influence on the amount of newly-produced yeast nor its fermenting power, and for these reasons the neutralization can be omitted entirely."

Petitioner's brief (pp. 30, 31) refers to the Wilfert article and says (p. 31) that Wilfert

> "deals only with preparatory operations and not with yeast propagation and makes no disclosure whatever of the use of nitrogen from inorganic ammonium salts that would release deleterious acid, and likewise no disclosure of the use of aqua ammonia or other antacid to combat such deleterious acidity in yeast manufacture."

As Wilfert employed only malt and grain in his mash, and no inorganic ammonium salts, he naturally did not advise neutralization of sulphuric or other acid derived from such salts. But he did point out clearly that if there should be excessive sulphuric acid, it might be advantageously neutralized. It did not require inventive genius to neutralize sulphuric acid, whatever its source in any stage of yeast manufacture, by adding an antacid.

D. Inorganic salts were old yeast foods, and it was known that harmful acidity from such salts could be neutralized.

The Hayduck 103 patent does not claim that it was new to use ammonium salts, either organic or inorganic, as yeast foods, and the clear fact is that they have been long known as useful yeast foods. Ammonium phosphate and

ammonium sulphate are disclosed in the Mohlant British patent 11,617 (pat., p. 2, ll. 11, 12, 2 R. 134), ammonium sulphate in the Fritsche Austrian patent 45/4047 (2 R. 154), ammonium phosphate in the Jacquemin British patent 21,011 (pat., p. 3, l. 5, 2 R. 129), and ammonium lactate in the Pollak Swiss patent 63, 539 (2 R. 152).

Every salt, upon decomposition, may be resolved into its acid component and alkaline (antacid, basic) component, and inorganic ammonium salts are not exceptions. As they are consumed by the yeast, they inevitably must release acid materials or alkaline materials, which necessarily must affect the degree of acidity of the yeast wort solution and the yeast in the solution.

The yeast manufacturer, knowing that for the best results the yeast solution must be maintained slightly acid, tests its acidity "from time to time" (*supra*, p. 9). If it is too acid, for any reason, he must neutralize, and if too alkaline, he must add acid. Whatever may be the materials employed in the yeast wort, it must be maintained slightly acid. Dangerous acidity was guarded against by frequent testing, as above stated.

Sometimes, but not always, inorganic ammonium salts will produce deleterious acidity which should be neutralized. The amount and kind of salts, the nature of other materials, the dilution of the wort, etc. may produce an undesirable excess of acidity, but also they may not.

Petitioner's contentions with respect to the 103 patent (petitioner's brief, pp. 15, 17, 35, 39), are largely based on the false assumption that inorganic ammonium salts can not be commercially used without neutralization. For example, petitioner's brief states (p. 17, footnote), "Respond-

ent conceded at the trial that it had infringed patent—103, if valid (R. I, 627.)". But respondent used these salts in each of three different processes, and in only one, abandoned long prior to trial, were the salts so used as to require neutralization, respondent conceding at the opening of trial that this process infringed, if the patent was valid. Respondent's other two processes used extensively, were like prior art processes using such salts, and they were found by the district court not to contain any substantial neutralization (opinion, 1 R. 627, 628; decree, 1 R. 636, 637, 638).

There is a plain statement in the prior art that acids released from inorganic ammonium salts may be harmful to the yeast and that such acidity can be advantageously neutralized. Obviously, an excess of acids may harm the yeast, because it grows best in only a slightly acid solution, and also because the particular acids may be poisonous. As pointed out in an article by Henneberg (Journal, Society Chemical Ind., 1908, p. 415; 2 R. 159):

> "In the case of ammonium salts, these must undergo decomposition in order to take part in the formation of proteins, the acid of the ammonium salt being liberated; if, therefore, this acid has a poisonous action on yeast, the corresponding ammonium salt will have a similar action."

For example, if sulphuric acid is harmful, then the salt ammonium sulphate may be harmful, because the salt will liberate sulphuric acid.

Haydurk did not discover that the injurious effects of inorganic ammonium salts upon yeast could be neutralized,

because this was disclosed in the same Henneberg article (2 R. 158), viz.:

> "The inorganic ammonium salts have an approximately equal poisonous action on both kinds of yeast. Under ordinary conditions, these nitrogenous substances form excellent nutrient materials for yeasts, their injurious action only appearing in the absence of certain salts, which are more especially compounds capable of *neutralizing* acids." (See also Pure Products article, 1908, 2 R. 164, to same effect.)

The Pure Products article (1908, 2 R. 164) is a discussion of the Henneberg article, and states (2 R. 166):

> "Inorganic ammoniacal salts without lime salts or bases are, therefore, injurious" to yeast.

There can be no reasonable doubt that Henneberg disclosed the gist of the Hayduck patent, as was rightly declared by the Circuit Court of Appeals for the Third Circuit (1 R. 674 to 679).

Petitioner's brief (p. 28) says that "the opinion of the Circuit Court of Appeals below ignores entirely the fact that Henneberg a year later in 1909 wrote a text book (Henneberg's Prakticum), which, as distinguished from his reports on experiments, contained a section for the practical guidance of the commercial yeast manufacturing art" and did not mention the neutralization of inorganic ammonium salts. First, there is no evidence when he "wrote" the book, which was published in 1909. There is no presumption that text books are written in the year they are published, and often years are required. Second, the disclosure in the 1908 Henneberg article is not weakened by absence

from one or more subsequent Henneberg publications. If Henneberg once published the substance of the Hayduck patent, it can not be later patented by another.

Hayduck did not discover any new principle of neutralization, and the patent is invalid, because of the prior art which has been cited.

E. Authorities on patentable invention.

The Hayduck 103 patent is invalid, because the patent on its face is for a non-inventive step over the prior art, and also because the patent was anticipated by the Henneberg work.

Thompson v. *Boisselier,* 114 U. S. 1, 11:

> "So, it is not enough that a thing shall be new, in the sense that in the shape or form in which it is produced it shall not have been before known, and that it shall be useful, but it must, under the Constitution and the statute, amount to an invention or discovery."

Pearce v. *Mulford,* 102 U. S. 112, 118:

> "But all improvement is not invention, and entitled to protection as such. Thus to entitle it, it must be the product of some exercise of the inventive faculties, and it must involve something more than what is obvious to persons skilled in the art to which it relates."

Altoona Theatres v. *American Tri-Ergon,* 294 U. S. 477, 486:

> "An improvement to an apparatus or method, to be patentable, must be the result of invention, and not the mere exercise of the skill of the calling."

Paramount Publix v. *American Tri-Ergon*, 294 U. S. 464, 473:

> "To claim the merit of invention the patented process must itself possess novelty. The application of an old process to a new and closely analogous subject matter, plainly indicated by the prior art as an appropriate subject of the process, is not invention."

It is plain that the neutralization of the Hayduck 103 patent was clearly indicated by the prior art of Pollak, Wilfert and Henneberg. Hayduck did not discover any new principle. It was known in yeast manufacture prior to Hayduck that undesired acid should be neutralized, wherever it tended to injure the yeast, whether lactic acid (Pollak), sulphuric acid (Wilfert), or by acids released from inorganic salts (Henneberg). It was said, pertinently here, in *Honolulu Oil Corp.* v. *Halliburton*, 306 U. S. 550, 562, "No discussion, in addition to the convincing exposition by the circuit court of appeals for the fifth circuit, is required to show that the method claimed in suit was clearly indicated in the prior art."

F. The decisions below.

The district court for Maryland, which sustained the three patents, was influenced by the fact that the Fleischmann Company had sold large quantities of yeast under the patents, overlooking, it seems to us, that large sales by a powerful leader of an industry, does not necessarily mean that the product sold was made by a process which resulted from inventive genius. That court said that Fleischmann Company "is the leading yeast manufacturer in this coun-

try", referring to its "great size" and that "The testimony bearing upon the commercial practicability and success of the yeast process of the plaintiff is very strong", *Fleischmann Yeast Co.* v. *Federal Yeast Corp.*, 8 F. (2d) 186, 198.

The opinion of that court erroneously declared that a principle known in the laboratory could be patented by a late comer in the field, who used it for large scale commercial production, stating, in connection with the prior Henneberg work, 8 Fed. (2d) 186, 198:

> "It is one thing to show that, when yeast is used in fermentation processes, its fermentative power and duration of life will be enhanced by offsetting deleterious acidity or that in producing pure yeast cultures in the laboratory with distilled water, antacid substances should be used, and it is quite another to demonstrate that, when the end in view is the production of large quantities of yeast for its own sake, neutralizers may be advantageously employed."

Obviously, the use of an invention in a laboratory is one thing and the use of the same invention in successful commercial production is another. The latter may, and usually does, require executive ability, efficient organization, manufacturing technique, etc. But there is no sound justification for allowing a patent monopoly of an old invention, merely because of a first successful commercial use.

As the Circuit Court of Appeals for the Fourth Circuit affirmed on the opinion of the district court, 13 F. (2d) 570, the view in the Fourth Circuit was that the principle of neutralizing excessive acidity in yeast manufacture,

known to and described by earlier workers in the field, could be validly patented for commercial use by a later comer.

This erroneous view would probably have not been taken if this Court had previously rendered its decision in *DeForest Radio Co.* v. *General Electric*, 283 U. S. 664, where laboratory experiments by Lilienfeld and others invalidated the Langmuir "high vacuum" tube patent, despite the fact that Langmuir's company was the first to produce commercially such a tube. Although the Langmuir "high vacuum" tube was an improvement over the low vacuum tube of great importance" (*id.*, p. 678), the patent was found invalid, because it did not involve the inventive faculty.

In the present case, the district court for New Jersey, unduly respectful, we think, of the decision of the Circuit Court of Appeals for the Fourth Circuit, followed it (opinion, District Court, 1 R. 626), while the Circuit Court of Appeals for the Third Circuit correctly concluded that, as the Hayduck 103 patent failed to disclose any new principle, it should be declared invalid.

II. THE HAYDUCK PATENT 1,449,105 IS INVALID, FOR LACK OF PATENTABLE INVENTION AND FOR INDEFINITENESS.

The Hayduck 105 patent was applied for and was issued on the same dates, respectively, as the 103 and 106 patents, namely, October 30, 1920 and March 20, 1923. All the claims of the 105 patent were held invalid by both Courts below, on the ground of indefiniteness. The Circuit Court of Appeals strongly intimated, if it did not decide, that the claims were also invalid for want of patentable invention, saying (1 R. 683):

> "In our opinion the process described by Hayduck may constitute a mechanical improvement over the prior art but it is no more than this. But even if the process disclosed by Hayduck be held to constitute invention, the patent is invalid for indefiniteness as was held by the learned District Judge."

The district court for Maryland sustained claims 4, 8, 9 and 10, without deciding as to the other claims, against the defense of want of invention, *Standard Brands* v. *Federal Yeast Corp.*, 38 F. (2d) 329. The defense of indefiniteness was not raised before the Maryland court,* which, of course, did not pass upon it, and no appeal was prosecuted, because Standard Brands made a settlement with the defendant (1 R. 250, 593).

A. The 105 patent.

The object of the patent is to produce large quantities of yeast and a minimum of alcohol. In the fermentation process, some of the carbon compounds (sugar, etc.) will go into yeast cells and some will be converted into alcohol. The alcohol manufacturer controls the fermentation process so as to obtain much alcohol and little yeast, while the yeast manufacturer has the opposite object.

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*There was not a word of testimony by the defendant that the patent was indefinite, that experiments were required, or concerning the 3° to 5° Balling sentence (Ex. D-11). In the present case, there is in the record ample evidence on these points, supporting respondent's position (Rautenstrauch, 1 R. 171, 198-200, 203-204, 238, 252; Free, 1 R. 535-537, 566-570; Rautenstrauch, 1 R. 574-580; Free, 1 R. 591). During the trial below petitioner's counsel conceded that Judge Soper did not have the 3° to 5° Balling matter before him (1 R. 420).

The 105 patent states (p. 1, l. 10; 2 R. 5):

> "This invention relates to a process for the manufacture of yeast and particularly to a process for manufacturing a compressed bakers' yeast in which very little alcohol is produced as a by-product, and has for its object an improved procedure for manufacturing yeast in a more convenient and economical manner than heretofore."
>
> "In the manufacture of yeast according to the usual aeration process, large quantities of alcohol are generated, the amount of which is to some extent dependent on the sugar available for the yeast."

Hayduck did not discover that the amount of sugar in the wort determined the amount of alcohol which would be produced. The industry knew that alcohol was produced from sugar; and, therefor that the wort should have a low concentration, if yeast instead of alcohol was wanted. The 1903 Iwanowski article in the Journal, Soc. Chem. Industry (2 R. 157) stated:

> "(2) the higher the concentration of sugar in the nutrient solution, the stronger is the alcoholic fermentation; (3) in solutions which contain about 0.5 per cent. of sugar and about double that quantity of peptone, hardly any alcoholic fermentation is to be observed."

An example of an old process, for maintaining a low concentration, in order to avoid alcohol production and obtain a high yeast yield, is given in the Hayduck 105 patent (p. 1, l. 33, *et seq.*), saying:

> "The process disclosed in the German patent to Rainier, 10135, endeavors to reach this goal [high yeast yield and low alcohol yield] by adding the

nutrient required for the yeast (sugar and peptone); in a manner which would produce this result, *i.e., by adding the peptones continuously and the sugar at intervals, as required,* and whenever analysis showed the need thereof, stating that *in keeping the concentration of the sugar very low* the formation of alcohol is prevented and the sugar is used only as a nutrient."

Hayduck's German patent 300,662, corresponding to the 105 patent (translation, 2 R. 187), also refers to Rainer (which the Hayduck 105 patent misspells). It is said that in Rainer

> "the nutrients necessary for the yeast (sugar, peptons) are added in portions or continuously according to need and so slowly that the yeast utilizes the sugar not for the formation of alcohol, but only for the nutrition".

And again (2 R. 189):

> "In the process according to the patent 10,135 in fact also the periodical or continuous addition of sugar or peptons to the liquid containing the yeast is provided, by utilization of the high dilution which is of advantage for the growth of the yeast at the expense of the formation of alcohol".

Simply, Rainer states that a high yield of yeast and little alcohol may be obtained, by maintaining the wort at a high dilution, feeding the nutrients periodically or continuously, as may be required.

The dilution of sugar in the wort is about ½ to 1%, as specified in the Rainer patent (2 R. 139), saying that "in each instance only ½-1% of dextrose or other carbohydrate

shall be added" to the wort (called "mass"). By thus adding sugar "in portions or continuously according to need", the desired high dilution would be maintained. Petitioner's expert agreed that the Rainer concentration was about 1° Balling* (Lamb, 1 R. 473).

The Balling scale is used for densities in a yeast wort (Rautenstrauch, 1 R. 203), and one Balling degree is about one per cent. concentration (Agreed Statement of Facts, 1 R. 35).

Hayduck, recognizing that the Rainer process would have "the advantage of the high yield in the yeast" (105 pat., p. 1, l. 54; German pat., 2 R. 188), thought that the high dilution of the Rainer wort (about 1° Balling) would increase the cost of operation, and so Hayduck proposed to use worts of from 3° to 5° Balling, and to supply them with nutrients in some way so that the yeast would consume the alcohol produced by this wort of higher sugar content. This is clear from his United States and German patents.

The 105 patent, after referring to Rainer "keeping the concentration of the sugar very low", etc., (p. 1, l. 41 *et seq.*), states (p. 1, l. 54 *et seq.*):

> "In the process described hereinafter and forming the subject of this invention, the goal of obtaining a high yeast yield with little or no formation of alcohol is reached *by the use of worts of normal*

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*The Rainer concentrations are practical, because they are used in respondent's process, where "the actual density in the propagating vat during propagation was as shown in the exhibits and ranged from 1 degree Balling or slightly above at the start to a maximum of about 2.3 degrees Balling (on a yeast basis) at the end"; Agreed Statement of Facts, 1 R. 43.

> *quality and concentration,* the wort being added to the yeast continuously and at a rate such that no large excess of alcohol will be formed, and the yeast can assimilate most of the alcohol which is so formed."

By "worts of normal quality and concentration", Hayduck was referring to the worts commonly used in 1915 and which had concentrations of from 3° to 5° Balling (petitioner's expert Lamb, 1 R. 443). Hayduck proposed to obtain his normal wort by taking a part of a 12° Balling wort, diluting the part to 1° Balling and placing it in the fermenting vat, and then adding the 12° solution (pat. p. 1, l. 66, *et seq.*). The patent states that "The quantity of the diluted wort which is originally available for the yeast is so chosen, for example, that the mean content of the entire wort employed would be 3° to 5° Balling" (pat., p. 1, l. 90, *et seq.*). In this way Hayduck obtains the "normal" concentration of 3° to 5° Balling instead of the lower concentration of Rainer and others (including respondent).

The Hayduck German patent says (2 R. 188) this is "In contradistinction to the process of producing yeast from worts of very small concentration" and in referring to "the high dilution" of Rainer, says:

> "the operation with normally concentrated liquids has not been provided; the simple administration of the aforementioned process [Hayduck "normal" wort] is therefore missing which does not differ in any way from the normal process of the production of airation yeast in the production of the wort and in the expenditure of work".

The only difference between Rainer and Hayduck is that Rainer maintains a low dilution wort of about 1° Balling and Hayduck proposed to maintain a normal wort, of between 3° to 5° Balling.

The 105 patent says that with Rainer there is a "very low concentration of the sugar solution which is added from time to time to the fermenting wort" (p. 1, ll. 45 *et seq.*). But the Rainer patent does not state or imply that the added wort should have a "very low concentration," but merely that the sugar should be added continuously or periodically, as required to maintain the desired low concentration. There is no other limitation on the degree of concentration of the added sugar or peptone.

Petitioner's brief (p. 47) says that in the Maryland litigation "there was evidence that following Rainer's preferred process the yeast yield would be only 5% on the basis of the raw materials". It is true that petitioner offered such evidence in that litigation, but it failed to offer any in the present case (because, we think, petitioner realized this was not true). The only evidence in the present record is that of Dr. Rautenstrauch, who said the Rainer yield would be 125 to 150 per cent. yield on the sugar basis (1 R. 225), and Dr. Free, who operated the Rainer process (1 R., 287 to 303), finding that the yield on the basis of all raw materials used was in one case "41 per cent." and in another "53 per cent." (1 R., 295, 296). This testimony was given in respondent's case and thereafter petitioner put in its rebuttal case, with numerous witnesses and exhibits, including testimony by petitioner's expert concerning Dr. Free's tests (Lamb, 1 R., 421, 425, 428, 490, 491, 596 to 604, 607) and testimony regarding Rainer (Lamb, 1 R., 436, 437 to 441.

453, 513), but without a word in the record by any of petitioner's witnesses as to what would be the Rainer yield.

Petitioners' counsel now argue in their brief (pp. 47, 48) that the 53% yield obtained by Dr. Free was only 20%. There is nothing in the record to support this argument. They contend that Dr. Free caculated the yield on the basis of peptones and not the malt sprouts which produced the peptones, the latter being about one-third the weight of the former. But Dr. Free testified unequivocally that his yields were on the basis of "The raw materials including malt sprouts and all the rest of them" except water (Free, 1 R., 295), and records of his work, in evidence as respondent's Ex. D-4, show this (see pp. 4 and 5 for the 53% yield).

Petitioner's brief (p. 48) cites a 1912 book to the effect that the process of the 1879 Rainer patent "did not come to a successful realization". But this does not affect the broad disclosures of the patent. It may be that the specific materials and details of the Rainer process were not adapted to large scale commercial production, and that improvements were necessary. The same is true of many patents, including the Hayduck patents (none of which appears to have ever been used by anyone except in combination with many others). Also, in Rainer's time, there was no demand for the production of yeast without alcohol (*infra*, p. 53).

Petitioner's entire discussion of the Rainer patent (brief, pp. 44 to 50) misses the point. The question is not whether a prior patent discloses the precise method and materials, including specific proportions, of a later patent, but it is whether the later patent describes an inventive step over the first patent. Petitioner's expert on cross-examination stated the correct rule of interpretation, as follows:

> "XQ. 828. If you were reading that patent [Rainer], in order to obtain information from it, and you were endeavoring to practice that patent and use whatever data it had in it, would you necessarily follow the specific instructions of the patent?
>
> A. I think one should try to study the patent and see if there is a clear principle or idea there set forth and then should be guided by the central idea of the patent and the specific cases might serve as an illustration" (Lamb, 1 R., 514).

The Rainer disclosure that maintaining a very low concentration wort, by starting with a dilute solution and feeding nutrients as required, would produce much yeast and little alcohol, invalidates the Hayduck 105 patent.

It may be observed that continuous feeding of the nutrients, as the yeast grows and propagates, was also disclosed in the Delbrück article in Wochenschrift für Brauerei, 1903 (transl., 2 R. 174, 178):

> "The highest crop therefore is obtained by the continuous process of fermentation according to which there is first placed into a large fermentation vat the innoculating yeast together with a little wort, whereupon a *stream of fresh nutrient liquor is run in continuously*, distributed over, say 24 hours, until the receptable is full."

Clearly Hayduck did not "invent" the idea that the way to increase the production of yeast and to minimize the production of alcohol was to maintain a low concentration in the wort (Iwanowski), by feeding nutrients "as required" (Rainer process as stated in the Hayduck patent), or continuously (Delbrück). Indeed, this seems to be conceded in petitioner's brief (p. 19), which says that prior to Hayduck

"the art knew that high concentrations of sugar nutrient in the wort tended toward sacrificing yeast yield in favor of greater alcohol yield, but did nothing about it because other factors of cost and efficiency were practically involved;"

There was also the reason that prior to the last World War and to prohibition in this country "the desire was to create yeast and alcohol" (Rautenstrauch, 1 R. 234). But old knowledge can not be validly patented when it becomes economical to employ it, whether it is because of cheapness of materials, improvement in operations or a new demand.

The claims.

A patent monopoly is measured by the claims of the patent. "The claims 'measure the invention'," *General Electric* v. *Wabash*, 304 U. S. 364, 369, so the claims in issue must be examined. Petitioner asserts that the courts below erred in finding invalid all the ten claims of the patent, but, although petitioner has the burden on this appeal of establishing that the Circuit Court of Appeals below erred in holding that all the claims, with their different purported monopolies, were invalid, petitioner's brief fails to discuss any claim except clain. 10 (petitioner's brief, pp. 5, 41 *et seq.*). This should mean that petitioner has abandoned all claims except 10, by failure to present a *prima facie* case or argument. However, as it may mean that petitioner is seeking to reserve its contentions with respect to other claims to a reply brief, and thus prevent adequate answer, we shall select claims 1, 4 and 10 as typical and discuss them. They are as follows:

"1. A process of propagating yeast which comprises, initiating propagation of yeast in a dilute

nutrient solution containing all essential yeast nutrients, aerating the solution, and substantially continuously adding during the period of propagation, a solution containing all essential yeast nutrients."

"4. A process of propagating yeast with a relatively low yield of alcohol which comprises preparing a wort containing all essential yeast nutrients in solution, initiating propagation of yeast in a diluted portion of said wort, aerating the diluted portion, and substantially continuously adding during the period of propagation, a wort of higher concentration, at a rate such that the yeast may propagate and substantially all of the alcohol which may be formed is assimilated by the yeast."

"10. A process of propagating yeast with a relatively low yield of alcohol which comprises, preparing a wort containing all essential yeast nutrients in solution, initiating propagation of yeast in a highly diluted portion of said wort, aerating the diluted portion, and substantially continuously adding during the period of propagation, the wort of higher concentration at a rate such that the concentration of the dilute wort remains substantially constant, whereby substantially all of the alcohol which may be formed is assimilated."

The gist of claim 1 is a substantially continuous addition of all essential yeast nutrients during the period of propagation. This claim was in the Maryland litigation, but the district court, pointing out that it "omits any reference to the rate of feed", *Standard Brands* v. *Federal Yeast*, 38 F. (2d) 329, 338, declared that it was unnecessary to consider whether the claim could be saved by reference to the specification, as "other claims of the patent, limited as they are

by reference to the rate at which the concentrated wort is added, are valid," (p. 338). We think that it should be found invalid, because it is too broad on its face and it should not be construed to mean the same as other and narrower claims.

Claim 4 has the additional feature of the rate of addition. Claim 10 adds to claim 4 the statement that the rate of addition should be "such that the concentration of the dilute wort remains substantially constant". These two claims were sustained in the Maryland litigation, because of the rate of feed feature.

In the courts below, claim 4 was selected as typical, as appears from the opinions (district court opinion, 1 R. 630; C. C. A. opinion, 1 R. 681).

B. The prior art invalidates the patent.

No new principle is disclosed in the Hayduck patent. The idea of using a wort of *normal* concentration instead of a wort of *low* concentration, to obtain high yeast yields and low alcohol yields, did not rise to the dignity of a patentable invention. No new result was obtained, but merely what the old Rainer process obtained, as stated in the Hayduck patent, namely, "the advantage of the high yield in the yeast" (Hayduck, pat., p. 1, l. 52).

It was known that the production of alcohol could be controlled, by maintaining low concentration worts, Iwanowski and Rainer; that continuous feeding of nutrients might be desirable, Rainer and Delbrück; and that the feeding could be by "the addition of a concentrated to a highly diluted portion of the wort" (*Federal Yeast* opinion, 38 F. (2d) 337, referring to Kamienski German patent,

269, 192, 2 R. 142). It did not require inventive genius to use these principles with a wort of "normal" concentration.

The district court for Maryland pointed out that the Rainer patent and other prior art disclosed all the principles proposed by Hayduck, but decided that the combination of these old principles amounted to patentable invention, saying 38 F. (2d) 337:

> "The division of the wort into two parts, the beginning of propagation in one part, which had been diluted, and the addition of the other part continuously or at intervals, the restriction of alcohol production by regulating the supply of sugar—these several suggestions may be gathered together from the literature. But no publication shows the combination of elements found in claims 4 and 10 of the patent."

But that court was wrong and the Circuit Court of Appeals for the Third Circuit was right in declaring "In our opinion the process described by Hayduck may constitute a mechanical improvement over the prior art but it is no more than this" (1 R. 683).

C. The patent is invalid, because of indefiniteness.

The principles of law relating to the requirements of definiteness in patents are well settled.

Consolidated El. Light Co. v. *McKeesport Light Co.* (Incandescent Lamp case), 159 U. S. 465, 474:

> "If the description be so vague and uncertain that no one can tell, *except by independent experiments*, how to construct the patented device, the patent is void."

In *General Electric Co.* v. *Wabash Co.*, 304 U. S. 364, this Court said (p. 369):

> "* * * Patents, whether basic or for improvements, must comply accurately and precisely with the statutory requirements as to claims of invention or discovery. The limits of a patent must be known for the protection of the patentee, the encouragement of the inventive genius of others and the assurance that the subject of the patent will be dedicated ultimately to the public. The statute seeks to guard against unreasonable advantages to the patentee and disadvantages to others arising from uncertainty as to their rights. The inventor must 'inform the public during the life of the patent of the limits of the monopoly asserted, so that it may be known which features may be safely used or manufactured without a license and which may not'."

The claims of the Hayduck 105 patent are too indefinite. If infringement depended upon how successful a process was, the test would not be only whether a patented invention had been used, but the commercial ability of the manufacturer, his competition, labor conditions, etc. That is not the law. This Court declared in the *Wabash* case (p. 371):

> "A limited use of terms of effect or result, which accurately define the essential qualities of a product to one skilled in the art, may in some instances be permissible and even desirable; but a characteristic essential to novelty may not be distinguished from the old art solely by its tendency to remedy the problems in the art met by the patent."

Even if Hayduck had discovered some particular rate of feeding the nutrients, so that little alcohol would be pro-

duced, he would not be entitled to a patent for every rate which would perform the same function. This Court declared in *Holland Furniture Co.* v. *Perkins Glue Co.*, 277 U. S. 245, 257

> "A claim so broad, if allowed, would operate to enable the inventor who has discovered that a defined type of starch answers the required purpose to exclude others from all other types of starch and so foreclose efforts to discover other and better types. The patent monopoly would thus be extended beyond the discovery and would discourage rather than promote invention. *The Incandescent Lamp Patent, supra,* 476. That the patentee may not by claiming a patent on the result or function of a machine extend his patent to devices or mechanisms not described in the patent is well understood."

These principles may now be applied to the patent, and its alleged invention of feeding the yeast at a rate which is defined in the description as "a rate such that no large excess of alcohol will be formed, and the yeast can assimilate most of the alcohol which is so formed" (p. 1, l. 60 *et seq.*) and in typical claim 4 as "at a rate such that the yeast may propagate and substantially all of the alcohol which may be formed is assimilated by the yeast".

Claim 4.

What is the rate intended to be monopolized by claim 4? The remainder of the patent fails to teach what it should be and the reader is left entirely in the dark. The patent does not disclose whether, maize, corn, malt, rye, barley, potatoes, molasses, sugar beet, sugar, ammonium salts or other well known yeast foods (prior art patents, 2 R. 91 to

101) should be used, nor, of course, what should be the proportions of the nutrients in the wort. The patent says (p. 1, l. 99) "the yeast is constantly given new supplies of all nutrient constituents necessary for the propagation" and "there is always a wort concentration, by means of which the nutrients and the resultant substances are absorbed most efficaciously and quickly by the yeast". But what are these "nutrient constituents", and what is their rate of supply? The patent merely says that the *rate* should be whatever rate the operator may discover by experiments, which will result in a yeast yield, satisfactory to the operator, with a minimum of alcohol. As the district court below remarked, "it leaves the inquirer to experiment and by trial and error find out for himself what the rate may be" (1 R. 632), the Circuit Court of Appeals reaching the same conclusion (1 R. 683).

The yeast manufacturer did not need to be told by Hayduck that the concentration of nutrients in a wort was important, that some concentrations were better than others, that there was an optimum nor that the optimum, for his materials and process, could be ascertained by tests and experiments. The statement in the Hayduck patent that the nutrients should be supplied to the yeast at a rate such that a good yeast yield and little alcohol could be obtained was merely a statement of a problem, which the yeast manufacturer himself had to solve by experiments. Petitioner's expert admitted that yeast manufacturers prior to 1914 knew that the optimum concentration for large yeast yield and little alcohol could be obtained by experiments.

"XQ. 564. Does this patent say anything more about the rate of feed other than that it should be

a good rate of feed, namely, one that did not produce too much alcohol and one that gave the proper nourishment to the yeast?

A. I do not think that your statement is quite a fair one of the direction. The direction to furnish suitable quantities so that the yeast would have the optimum concentration of food for its growth is something more than just a general direction that you could characterize as good. Of course, to a yeast manufacturer it at once becomes evident that this optimum condition of the right concentration could be regulated and controlled simply by observations of the density of the liquid, the nutrient liquid during yeast propagation. This is a procedure which every yeast manufacturer is familiar with and which he would immediately adopt in order to secure this goal, this optimum condition, to which Hayduck calls attention. *It is my view that the yeast-makers of 1914 would know those things.*

XQ. 566. So that when Hayduck says you should feed the yeast with concentrated wort at such a rate that the yeast would grow well and there wouldn't be too much alcohol, your view is that the yeast-maker would know by testing and experiment what the different rates should be?

A. He could tell by his Balling readings what the proper rate was, and he could soon tell from his yields and from the production or non-production of serious amounts of alcohol as to whether he had really achieved this end that Hayduck had pointed out to him" (1 R. 457).

This "end" was not new with Hayduck, as it had been pointed out by Rainer and Iwanowski. Hayduck does not tell how this end is to be accomplished, and, as declared in

the Selden patent case, *Columbia Motor Car* v. *Duerr*, 184 Fed. (CCA 2) 893, 908:

> "A patent is granted for solving a problem, not for stating one. Its description must explain the invention itself, the manner of making it, and the mode of putting it in practice. In the absence of knowledge upon these points, the invention is not available to the public without further experiments and further exercise of inventive skill."

If experiments are necessary, the patent is void. In the present case, the evidence by both sides is entirely clear that tests and experiments would be necessary for the discovery of what should be the rate of feed, for any specific manufacture.

It is plain common sense that, as petitioner's witness Feild said on cross examination (1 R. 385), the rate of growth of the yeast

> "depends upon many variables. The more important ones are the amount of raw materials, the concentration of them, the kinds of raw materials, the preparation of the raw materials, the temperatures, the aeration and the rates of feed and many others. All those factors enter into the question of how quickly or how slowly you should feed the solution into the yeast."

With any particular set of factors, experiments are necessary to ascertain the best rate of feed.

> "* * * what I am asking you is how you determine, in your judgment, as a practical plant superintendent or production man, what that rate [of feeding] should be, whether it should be very quick or very

slow or whether it should change during the period or how?

A. You don't determine it at any one time but by a series of experiences" (Feild, 1 R. 384).

Respondent's witnesses Dr. Rautenstrauch (1 R. 574) and Dr. Free (1 R. 591), also acquainted with the practical manufacture of yeast, agreed with petitioner's witness that experiments are necessary to determine a rate of feed which, under the particular conditions, will give the desired results. As the patent gives no guide to the best rate of feed, saying merely that it is desirable to feed at a rate which will be beneficial to the yeast and will not produce alcohol, the patent merely states a known problem, not a solution, and the patent was correctly declared invalid for indefiniteness.

Claim 10.

Claim 10 is fatally indefinite, for the same reason as claim 4, namely, failure to teach how the known desirability of a dilute concentration during the fermentation process could be obtained.

Petitioner's brief (pp. 42, 43, 52) contends that claim 10 means that the rate of feed should be such that the wort concentration in the propagating vat is maintained at about 1° Balling, on the theory that the phrase in the claim, "the concentration of the dilute wort remains substantially constant" means a substantially constant dilution of 1° Balling. This contention is both erroneous and immaterial. First, the claim defines the wort as "dilute" and not as a wort of about 1° Balling dilution. Second, the specification of the patent is clear that the Balling of "the dilute wort" is

between 3° and 5°. And, third, it is immaterial with respect to the defense of indefiniteness whether the rate specified in the claim is a rate to produce much yeast and little alcohol, a rate to produce a "dilute" wort (which will result in much yeast and little alcohol) or a rate to produce a 1° Balling wort. In each case, the desirability of such a rate was known and the Hayduck patent does not teach how to obtain it, nor add to the previous knowledge that experiments were necessary.

Petitioner made a strenuous effort at the trial to establish its contention that Hayduck proposed to employ a low concentration of about 1° Balling (like Rainer and respondent), instead of "normal" concentrations of about 3° to 5° Balling, but was unsuccessful, the district court declaring "There was a sharp conflict" (opinion, 1 R. 643), without deciding it, and the Circuit Court of Appeals being silent on the point. It does not seem material here whether the "dilute wort" of claim 10 is 1° Balling or 3° to 5° Balling, for the reasons above stated. However, if it should be considered material, the evidence is that "the dilute wort" of claim is between 3° to 5° Balling, and is neither the 12° Balling wort or the 1° Balling wort mentioned in the patent.

The evidence on this point consists of what seems to us (and to respondent's witnesses) the plain language of the patent, and the opinions of the witnesses as to its meaning. The Hayduck 105 patent proposes to use a wort of "normal" concentration (Hayduck pat., p. 1, l. 58), correctly said by petitioner's expert to be from 3° to 5° Balling (Lamb, 1 R. 443), as contrasted with "the very low concentration" of Rainer (Hayduck 105 patent, p. 1, l. 44), which petitioner's expert said was about 1° Balling (Lamb, 1 R. 573). It was Hayduck's idea that the alcohol which

would necessarily be produced in his wort (because he had a "normal concentration"), would be assimilated by the yeast, as contrasted with the Rainer proposal to avoid production of alcohol, by using a very low concentration.

The process described in the Hayduck 105 patent (p. 1, l. 65 *et seq.*) is to place in the vat some "highly diluted" wort, about 1° Balling. Thereafter a 12° Balling wort ("the concentrated wort") is added, and "the mean content of the entire wort employed would be 3° to 5° Balling" (Hayduck pat. p. 1, l. 94). Claim 10 states that to the "highly diluted portion of said wort" is added "the wort of higher concentration", and "the concentration of the dilute wort remains constant". By "dilute wort" was meant the wort composed of both the "highly diluted portion" and the added "higher concentration" wort, the average being a "normal" wort of between 3° and 5° Balling.

Petitioner's expert witness had great difficulty in contending that the 3° to 5° Balling did not mean the concentration of the wort consumed by the yeast. (He was a chemistry professor, who had never had any practical experience in yeast manufacture or been associated with any yeast manufacturer other than the petitioner, for whom he testified in the Maryland suits, Lamb, 1 R. 52.) At one time he said that the 3° to 5° "language is really crystal clear once you see what it is all about, couldn't be stated more elegantly and exactly than it is stated" (Lamb, 1 R. 351) and at another time that "It is just an arithmetical relationship, stated, unfortunately, too briefly" (Lamb, 1 R. 362). However, he finally declared that, upon his interpretation, the sentence refers to "a purely hypothetical experiment" and "It is a wholly conditional—it is an

imaginary situation" (Lamb, 1 R. 369), not relating to the wort as used by the yeast in the fermenter.*

Petitioner also called two employees of the Federal Yeast Company (Feild, 1 R. 380; Kahn, 1 R. 618), but they did not testify as to the meaning of the patent as a whole, but merely as to whether their company used the formula which petitioner says is disclosed in the Hayduck patent. Petitioner had an injunction against their employer, restraining it from infringing certain patents (1 R. 383).

Respondent's witness, Dr. Rautenstrauch and Dr. Free, testified that they considered that when Hayduck said in his 105 patent "the mean content of the entire wort employed would be 3° to 5° Balling", he meant the wort used by the yeast and not a "purely hypothetical experiment".

Dr. Rautenstrauch was a Columbia professor of engineering, and also a consulting engineer, who has had extensive practical experience with yeast manufacture, was very familiar with yeast patents and other yeast literature (Rautenstrauch, 1 R. 243, 248, 249), and was exceptionally well qualified. He was vice president and general manager of the Liberty Yeast Corporation from 1923 to 1926 (which had several manufacturing plants and was a comparatively large manufacturer), when it was sold to the Fleischmann Company, for four million dollars (1 R. 164).

Dr. Free, another witness for respondent, was also well qualified to testify regarding the operations mentioned in the Hayduck 105 patent. He was a consulting chemist, a

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*Petitioner's counsel during the trial denied that the 3 to 5 language "concerns the rate of feed during yeast manufacture", saying that it dealt "with the preselection in preparation to begin" (1 R. 410), and that "It has nothing to do with the feeding, with the rate of feeding. It has a great deal with (sic) do with the yeast manufacture" (1 R. 412).

member of the faculty of New York University, a chemist of the State of Arizona, and also a chemist and a scientist with the United States Department of Agriculture (1 R. 256), consultant for many years with California concerns and breweries manufacturing yeast and other fermentation products, namely, wine and beer (1 R. 270), and was competent to testify regarding yeast manufacture (Free, 1 R. 535). His judgment testifying as a chemist "would be exactly the same judgment if I were testifying as a practical yeast manufacturer" (1 R. 542). The reason for this was because he has studied the yeast manufacturing processes of other manufacturers of bakers' yeast in the United States, having had direct first hand contact with yeast manufacturing processes as carried out commercially by companies in this country (Free, 1 R. 557 to 559).

If the meaning of the 3° to 5° Balling sentence is doubtful, the opinion of respondent's witnesses is entitled to at least as much weight as those of petitioner. However, as above stated, claim 10 would not be saved by assuming that "the dilute wort" meant 1° Balling, because the art knew that the wort should be maintained at a dilution of about 1° Balling, by feeding nutrients as required.

The use of a density gauge does not save the patent.

Petitioner's brief (p. 52 *et seq.*) argues that the patent discloses a rate of feed such that the wort density will remain constant and that a saccharimeter, a density gauge, could be used to ascertain the density of the wort, and the feed of the nutrients thus regulated. The gauge, as stated in petitioner's brief, "is merely a float with graduations marked in degrees Balling, and the depth at which the

instrument floats in the wort can be read directly to indicate density of the wort".

But this does not aid the argument for definiteness. The gauge measures the total amount of solids in the wort, including seed yeast, propagated yeast, grain materials, molasses materials, salts, etc., and does not measure the amount of sugar in the wort, as pointed out by respondent's witnesses, without contradiction (Rautenstrauch, 1 R. 203, 204; Free, 1 R. 264, 581). Two worts might have the same percentage of sugar but very different Ballings, because of the other materials employed.

It is true that after experiments have been made to ascertain what rate of feed, with the particular materials used, amount of seed yeast, etc., will produce optimum results, such rate can be ensured for subsequent operations. But, the Rainer patent pointed out that the nutrients should be supplied "whenever analysis showed the need thereof" (Hayduck 105 pat., p. 1, l. 39) and required "a continuous observation of the conditions of the nutrients in the liquid" (Hayduck German patent, 2 R. 189), which is all that petitioner seems to be now claiming for Hayduck.

D. Petitioner apparently could not use the patent without experiments.

The petitioner in 1919 acquired rights to the alleged Hayduck inventions, and then commenced using the neutralization process of Hayduck patent 1,449,103 (Luce, 1 R. 102; 1 R. 593). Petitioner had the same right to use a continuous feed, instead of a batch operation, because of its ownership of the application for the 105 patent, which petitioner now says contains a very valuable disclosure of how to manufacture yeast. But it was not until 1923 that

petitioner used the process of the 105 patent (Luce, 1 R. 104; 1 R. 593). Petitioner failed to explain this four years delay, and it is unbelievable that, if this patent really disclosed a valuable contribution to yeast manufacture, petitioner, the largest yeast manufacturer in the United States, would not have immediately employed it, as it had every right and incentive to do. The conclusion is irresistible that the disclosure of the patent was inadequate, without extensive experiments.

III. HAYDUCK PATENT 1,449,106 IS INVALID FOR LACK OF PATENTABLE INVENTION AND FOR INDEFINITENESS.

Hayduck patent 1,449,106 was declared valid by the district court for Maryland, in the Federal Yeast litigation, as to the claims there in suit, namely, 1, 3, 4, 5, 6, 8, 12, 13 and 15, while the same claims were found invalid in the present case by both courts below, except claim 15, not in suit.

The alleged invention appears from the agreed statement of facts (1 R. 38):

> "8. Patent 1,449,106—The process of this patent is one combining the process of patent '103, including neutralization, and the process of patent '105, including regulated nutrient feed."

Although some of the claims in suit (1, 2, 3) do not specifically mention neutralization, the only process described in the patent employs that feature, and the parties agree that the patent is for the idea of using neutralization; the subject of the 103 patent, in combination with the proposal of the 103 patent to use a "rate of feed" suitable for production of much yeast and little alcohol.

The patent is merely for adding together the features of neutralization and rate of feed. There is no evidence that either neutralization or rate of feed operates differently when combined than when separately employed. Petitioner's brief (p. 7) says that the combination was "into a unitary process possessing more than the additive advantages of each". Petitioner does not say what such advantages might be, we do not know, petitioner does not cite the record for support of this assertion, and there is no support.

Claim 4 of the 106 patent is typical:

> "4. A process of propagating yeast with a relatively low yield of alcohol which comprises suspending seed yeast in a non-toxic aqueous liquid, aerating said liquid, substantially continuously adding thereto sugar material and yeast nourishing inorganic salts from which components are liberated which tend increasingly to acidify the solution during propagation, *which addition is at a rate such* that the concentration of the aerated liquid does not arise above that at which substantially all of the alcohol which may be formed is assimilated by the yeast, and during the period of propagation *neutralizing* the deleterious excess of such acidity."

Claim 13, referred to in petitioner's brief (pp. 5, 6), differs from claim 4 in the same manner that claim 10 of the 105 patent differs from claim 4 of the same patent.

A. The 106 patent is invalid, for lack of invention.

In the present case, the courts below considered whether it was a patentable invention to combine the 103 and the 105 procedures, and decided that it was not. The district

court for New Jersey said that as the 105 patent was invalid "its combination with a valid patent (103 patent) adds nothing to the art. This patent is therefore invalid" (1 R. 634), and the Circuit Court of Appeals for the Third Circuit declared "Since we have found patents Hayduck—103 and Hayduck—105 to be invalid it follows that we find this patent to be invalid since combining the processes of invalid process patents cannot result in validity" (1 R. 684). The decision was right that there was no patentable invention in proposing to supply a neutralized wort with nutrients at a rate such that substantially no alcohol will be produced.

As stated in connection with the 103 and 105 patents, the yeast industry knew that the wort should be maintained slightly acid (for yeast growth) and at a low concentration (to minimize alcohol production), that acidity could be controlled by neutralization, and that concentration could be controlled, by adding the nutrients in accordance with their consumption by the yeast, so that alcohol would not be produced.

It was well within the skill of the art and it did not require inventive genius, either to neutralize as required or to feed as required, and far less, these two matters being known, to use them together. A yeast manufacturer using continuous feeding would naturally neutralize his wort if it became too acid, and to do so would not require the genius of an inventor. Similarily, a manufacturer using such materials as required neutralization from time to time could readily employ the feature of continuous feeding without requiring an invention to do so. The 106 patent was correctly held invalid.

The district Court for Maryland did not decide the question of whether it constituted patentable invention to use together the features of neutralization and rate of feed.

The court took the position that Hayduck, because his application for the 106 patent was pending in the Patent Office at the same time as his applications for the 103 and 105 patents need not meet that question, saying, 38 F. (2d) 329, 343:

> "It has been held that, in the case of co-pending applications by the same inventor relating to the same art, it is not necessary to the validity of the claims of the latter application that they should embody a patentable advance over the earlier disclosure. The test is not whether the step between the earlier and later claims required invention".

This is not the law, nor is it sound. Why should an inventor who files an application based upon a real invention, and then files applications for minor improvements, be granted valid patents for such improvements? He has received his reward by the grant of a patent for his invention. Neither he nor anyone else should be permitted to monopolize non-inventive improvements, by other patents. If the improvement patents happened to issue later than the principal patent, as they ordinarily would, the result might be a prolongation of the monopoly of the first patent. The 103, 105 and 106 patents all issued on the same day, so that there is no such prolongation, but this does not affect the principle that only one patent can issue for an invention and that each patent must represent a patentable advance over all prior art, including that of the inventor.

In *Underwood* v. *Gerber*, 149 U. S. 224, the plaintiff had two patents, the applications for which were copending, and, as here, the patents issued upon the same day. The first numbered patent was for a particular composition of matter and the second numbered patent was for spread-

ing the composition upon paper. Suit was brought upon the second patent, which was held invalid, because there was no patentable invention in spreading upon the paper the composition of the first patent. If, as petitioner contends, a co-pending application can not be used to test invention, this Court could not have invalidated the second patent because of the first patent.

Miller v. *Eagle Mfg. Co.*, 151 U. S. 186, 198, states:

> "In *Underwood* v. *Gerber*, 149 U. S. 224, it was ruled that where a patentee obtained two patents on the same day, upon applications filed on the same day, they could not be treated as one patent with two claims, and that the complainant in suing upon the second, or the one having the latest number, could not use the first, or the one with the earlier number, to help sustain the action."

Even in a single patent, each claim should be considered "as setting forth a complete and independent invention", and "where a patent contains two claims which are alike, except that the narrower one of them calls for an unpatentable addition to what is called for by the other, the narrower claim is void" (*Walker, Patents*, Deller Ed., p. 1275), citing authorities.

Each invention must be examined on its own merits. A neutralized wort might be an invention and a particular method of supplying nutrients to a wort might be an invention, for which patents should be granted. But the idea of combining them is not necessarily a patentable invention. Assuming that it is not, and that one coming after Hayduck would not be allowed to patent this idea, why should Hayduck, who has precisely the same idea, be allowed a patent for it? In each case, the mental concept would be the same,

namely, to combine the two steps, and it would be clearly unsound to allow a patent monopoly in one case, although not allowable in the other, when the contribution of each to the public was identical. The existence of co-pending applications does not destroy the necessity for invention, and in such cases also, a patent is invalid if it "involves only the exercise of ordinary faculties of reasoning upon the materials supplied by a special knowledge, and the facility of manipulation which results from its habitual and intelligent practice" and "is in no sense the creative work of that inventive faculty which it is the purpose of the Constitution and the patent laws to encourage and reward", *Hollister* v. *Benedict Mfg. Co.*, 113 U. S. 59, 73.

There was no patentable invention in using the "rate of feed" proposed in the 105 patent with the neutralization proposed in the 103 patent, and, for that reason, the 106 patent is invalid.

B. The patent is invalid, because of indefiniteness.

The 106 patent is invalid for the same reason as the 105 patent, indefiniteness. The 106 patent states (p. 1, l. 70, *et seq.*):

> "The manipulative operation of the process is the same as described in German Patent 300,662 and in the aforesaid corresponding copending application for United States Patent Serial No. 420,832."

The German patent (2 R. 187) corresponds to the 105 patent, and the "copending application" resulted in the 105 patent; the "rate of feed" of that patent is an essential part of the 106 patent and because of the indefiniteness of such rate, the 106 patent, like the 105 patent, is invalid.

C. Double patenting and too broad scope are not issues here.

In the *Federal Yeast* case, the district court considered two defenses, neither of which was made here.

The defense of double patenting, clearly without merit, was overruled. There is double patenting when two patents have substantially the same claims. That is not the situation here, because the 103 patent claims neutralization, the 105 patent claims "rate of feed", while the 106 patent claims the combined use of neutralization and "rate of feed".

The defendant in the Maryland case also contended that the 106 patent was invalid, on the ground that it covered grain mashes, but this was summarily disposed of by the district court, which held that the patent did not cover grain mashes, 38 F. (2d) 344. No such contention has been made in the present case.

IV. COMMERCIAL SUCCESS WOULD BE IMMATERIAL AND IT WAS NOT SHOWN.

Petitioner's principal contention is that the three patents in suit should be sustained, because of "the practical commercial results accomplished by the patented processes" (brief, pp. 7, 8), "the industrial advance made by Hayduck" (*id.*, p. 10), "The Patented Inventions have Revolutionized the Art" (*id.*, p. 11), "petitioner had up to the time of trial made over one billion seven hundred million pounds of yeast" under the patents (*id.*, p. 17) and "the patented inventions revolutionized the industry" (*id.*, p. 58). But "* * * it is only when invention is in doubt that advance in the art may be thrown in the scale". *Paramount Publix*

Corp. v. *American Tri-Ergon Corp.*, 294 U. S. 464, 474, and the present case is clear for invalidity.

Also, petitioner has failed to establish that any commercial success was due to its use of the features of the three patents now before the Court. It is true that petitioner, long the greatest yeast manufacturer in this country, has sold very large quantities of yeast, but these large sales are accounted for at least in part by greater demand for baker's yeast, because of increase in the rate at which bread is being made in the bakeries as compared with home baking and increase in the population (Rautenstrauch, 1 R. 251). It may also be observed that prior to 1914, the fermentation process usually produced substantial quantities of both yeast and alcohol, and it was not until the advent of the last World War, which made it desirable in Germany to grow yeast for stock food and in this country to produce yeast instead of the Prohibition forbidden alcohol, that there was a demand for the production of only yeast (Rautenstrauch, 1 R., 234, 235).

It also appears that the features of at least thirteen patents were employed in petitioner's manufacture of yeast (*supra;* p. 5), and no endeavor was made to show the relative importances of these features.

As said in *Textile Machine Works* v. *Louis Hirsch Textile Machines*, 302 U. S. 491, 498:

> "Petitioner relies on the novelty of conception reinforced by an alleged commercial success. Commercial success may be decisive where invention is in doubt, but an insuperable obstacle to the invocation of that doctrine here is our inability, like that of the court below, to say 'that an art which knew how to reinforce "full-fashioned" webs without re-

entrant angles, and straight edged webs with such angles, required some uncommon talent merely to conceive of combining the two, for, as we have said, the patent can only stand on the bare conception.'"

* * * * * * * *

"Upon the record before us we cannot say that the commercial success is attributable to novelty of the bare conception of the use of the attachment with full-fashioned knitting machines rather than to the skill with which the patentee devised mechanisms for making the attachment effective, but for which he made no claim, or to the strength of the hands into which the patent came."

De Mayo Coaling Co. v. *Michener Stowage Co.*, 231 Fed. (CCA 2) 736, 737:

"The District Judge evidently was largely influenced by the circumstances that patentee's apparatus was generally accepted and has had a great commercial success. Such a circumstance is frequently persuasive evidence of patentable novelty. In this concrete case, however, the weight of such evidence is much reduced because the single claim in controversy does not cover the whole of patentee's device, but only a part of it, and it cannot be ascertained from the evidence that that particular part is what secured general acceptance."

National Sweeper Co. v. *Bissell Carpet Sweeper Co.*, 249 Fed. (CCA 2) 196, 198, 199:

"we may assume for argument's sake that each of these companies manufactured from the outset under each of the three patents, and that the credit of the invention is to be attributed equally to all; yet it is obviously quite impossible to say that the

> success was due to any one of the elements contributed by all. It is, indeed, impossible, upon this record, or upon all three records, for us to say that the success was due to all three together, assuming that would serve if we did. We do not question that success awaited any successful hand-driven vacuum cleaner; but we must be able to attribute the success to the invention * * *".

Petitioner failed to offer any evidence showing, or tending to show, that its large sales of yeast were due to the claims of the three patents now in question. Such failure, especially in view of petitioner's allegations in bills of complaint that it had profitably employed the process of thirteen patents, including the three, in its yeast manufacture, destroys the foundation for a contention that the patents should be sustained because of commercial success.

Paper patents can anticipate.

In connection with its claim of commercial success, petitioner refers to the prior art as "paper art" (brief, pp. 24, 28, 34), apparently contending that a disclosure of a process or principle in a prior patent or publication must be disregarded unless the evidence shows that there was successful commercial use of the process or principle. That is not the law. The public is entitled to rely upon such disclosures, without going to the trouble and expense of proving actual operation under them. The test of patentability is invention, not first commercial operation, and the patent statutes reward invention and not diligence in using known principles which, when first disclosed, may not have met with commercial success. In *Smith* v. *Hall*, 301 U. S. 216, 233, the Smith patent, for a method of incubating eggs, was

declared invalid, because "The Smith method was 'known or used by others in this country before his invention or discovery thereof'. 35 U. S. C. § 31". A prior use by one Hastings, although it had no commercial success, invalidated the patent, this Court stating (p. 232): "It is immaterial that his structure for using the method was neither the best possible nor as skillfully designed or used as that later employed by Smith".

In *Pickering* v. *McCullough*, 104 U. S. 310, 319, the objection to prior patents on the ground they were "paper" patents was overruled, because the objections to them "could be removed by mere mechanical skill, without the exercise of the faculty of invention". In *Dashiell* v. *Grosvenor*, 162 U. S. 425, 432, this Court referred to a prior art machine, saying "The very fact that a machine is patented, is some evidence of its operativeness, as well as of its utility,".

The issue of the patents by the Patent Office is entitled to little weight.

Petitioner argues that the patents should be sustained, because they were issued by the Patent Office, saying "patent -103 was allowed by the Examiners in the Patent Office in the face of the same prior knowledge now presented in defense to its validity" (brief, p. 34) and that "The Circuit Court of Appeals below found patents -103 and -105 invalid * * * * despite the fact that the same or substantially the same art had been before the Officials of the Patent Office, who had allowed the claims in suit thereover" (*id.*, p. 58).*

*The Patent Office did not have before it the articles of Wilfert, American Distillers' Review, Delbruck or Iwanowski, the two Henneberg abstracts, the Molhant, Fritsche or Jacquemin patents, or the evidence regarding their disclosures.

But the prosecution of a patent application is usually ex parte and the Patent Office issues patents when there is any reasonable doubt as to their possible validity.

> "In case of ordinary doubt, the policy of the patent system, as customarily maintained in the Patent Office, has been to give the applicant the benefit thereof, because no absolute right of property is conferred by the grant of a patent. (*Ex parte Fanshawe*, C. D. 1891, 203; 57 O. G. 1127). The patentee is merely put in a position to assert his prima facie right against infringers who may, in their defense, raise the question of the validity of the patent, and have the same finally adjudicated in the light of a full presentation and consideration of all the evidence attainable in respect of anticipation, prior knowledge, use, and the like." *In re Thomson*, 1906, C. D. 566, 571; 120 O. G. 2756.

To the same effect are the decisions by the Court of Customs and Patent Appeals, *In re Bronson*, 74 F. (2d) 726, 764, and *In re Hahn*, 55 F. (2d) 483, 484, the latter case holding that an applicant for a patent "is entitled, at least, to have any actual doubt resolved in favor of patentability".

In view of this policy of the Patent Office, the only presumption of validity attending the issue of a patent is that the Patent Office was not certain that it would be found invalid by the courts over the references considered by it. We believe that if the Patent Office had considered the additional prior art patents and publications discussed hereinbefore it would never have allowed the patents.

CONCLUSION.

The judgment of the Circuit Court of Appeals for the Third Circuit that the Hayduck patents, Nos. 1,449,103, 1,449,105 and 1,449,106 are invalid was correct and it should be affirmed.

Respectfully submitted,

STEPHEN H. PHILBIN
PAUL R. AMES
Counsel for Respondent.

October, 1939.

SUPREME COURT OF THE UNITED STATES.

No. 9.—October Term, 1939.

Standard Brands, Incorporated, Petitioner, *vs.* National Grain Yeast Corporation.	On Writ of Certiorari to the United States Circuit Court of Appeals for the Third Circuit.

[November 6, 1939.]

Mr. Justice McReynolds delivered the opinion of the Court.

The order which granted this Writ limits our consideration to the validity of Hayduck patents Nos. 1,449,103, 1,449,105, 1,449,106. They relate to processes for manufacturing baker's yeast and are owned by the petitioner. It will be convenient to designate them by the last three figures of their office numbers—103, 105, 106.

All three patents were declared invalid by the Circuit Court of Appeals below, 101 F. (2d) 814. In the District Court for New Jersey, 103 had been adjudged valid; 105 and 106 invalid, 21 Fed. Supp. 46.

The District Court for Maryland in two causes, (Soper. J.), held the patents valid, *Fleischman Yeast Co.* v. *Federal Yeast Corporation,* 8 F. (2d) 186, *Standard Brands, Inc.* v. *Federal Yeast Corporation,* 38 F. (2d) 329. The Circuit Court of Appeals, Fourth Circuit, affirmed the judgment sustaining 103, *Federal Yeast Corporation* v. *Fleischmann Co.,* 13 F. (2d) 570. The parties arrived at a settlement and no appeal was taken from the second judgment.

Much has been written relative to these patents in the carefully prepared opinions referred to above. They adequately reveal the facts and points of law incident to the prolonged disputation. Irreconcilable views have been approved and we must now decide which is to be preferred.

"Yeast is a small cellular micro-organism. In its ordinary significance, it is a conglomerate mass of infinitesimally small cells. It multiplies by self propagation, limited by the means of subsistence, and the quality and yield are greatly affected by the conditions under which propagation is carried on. Yeast has been man-

ufactured for at least 50 years by inoculating a wort; that is, by preparing a clear liquid solution and stocking it with a small amount of seed yeast. Such worts include substances to nourish the yeast cells, and are called yeast nutrient solutions. . . . The field for investigation and improvement has been the composition of the nutrient solution, and the character of the process employed during the period of growth."

Nutrient solutions often contain inorganic salts which are broken down through the growth of the seed yeast. Commonly, this brings about marked acidity. Growth progresses best in a slightly acid wort; over-acidity retards or destroys it; aeration of the wort accelerates growth.

The amount of alcohol, consequent upon the growth of yeast cells has direct relation to the concentration of the wort. When intensified the yield of alcohol increases; when lowered there is less.

Generally: Patent 103 proposes to neutralize any deleterious acidity in a wort which contains inorganic salt by adding an antacid material; patent 105 requires the addition of nutrients during the growth of the yeast "at a rate such that the yeast may propagate and substantially all of the alcohol which may be formed is assimilated by the yeast"; patent 106 combines the neutralization idea of 103 with the rate of feed proposed by 105.

Claim No. 1 of patent 103, typical of all, follows—

"The process of manufacturing yeast which comprises preparing a yeast nutrient solution and propagating yeast therein with aeration, said yeast nutrient solution containing essentially sugar material and yeast nourishing inorganic salts from which components are liberated which tend increasingly to acidify the nutrient solution during propagation, and during the period of propagation neutralizing the deleterious excess of such acidity."

In respect of this petitioners' counsel maintain—

"It covers, rather, the integral coordination of propagating yeast with aeration in a prepared solution containing essentially sugar material and yeast nourishing inorganic salts from which results an increasing acidification tending to become deleterious, and neutralizing the *deleterious excess* of such acidity in the solution while the yeast propagation is being conducted."

The Circuit Court of Appeals below declared—

"We think that it cannot be denied that the use of antacid or basic materials as neutralizers for acidity in respect to yeast is old in the art. . . . We think that Hayduck has simply set forth

a technique which is useful in the manufacture of yeast under modern methods. Hayduck's disclosures do not attain to the dignity of invention. His process is the result of the exercise of the skill of the calling, the application of an old principle to a similar or analogous subject with no change in the manner of application and without any substantially different result."

And it accordingly held patent 103 invalid for want of invention over the prior art.

Considering all the circumstances and notwithstanding the very forceful arguments to the contrary, we think this must be accepted as the better view.

Claim No. 10, typical of patent 105, follows—

"A process of propagating yeast with a relatively low yield of alcohol which comprises, preparing a wort containing all essential yeast nutrients in solution, initiating propagation of yeast in a highly diluted portion of said wort, aerating the diluted portion, and substantially continuously adding during the period of propagation, the wort of higher concentration at a rate such that the concentration of the dilute wort remains substantially constant, whereby substantially all of the alcohol which may be formed is assimilated."

Of this patent counsel for petitioner say—

It "is directed particularly to this procedural or manipulative, rather than chemical, aspect of the operation; i.e., a division of the wort into two parts with propagation begun in a diluted fraction and the gradual feeding in of the concentrated reserve as stated. By adopting this perfected process, the yield of yeast was still further increased and there were also other accompanying advantages in shortened time from commencement of the yeast propagation to the harvesting of the yeast crop and in enhanced quantity of output from a given sized apparatus."

The Circuit Court of Appeals below declared—

"It was well known to the prior art that if the creation of alcohol was not desired the nutrient solution should contain a low concentration of sugar. . . . In our opinion the process described by Hayduck may constitute a mechanical improvement over the prior art but it is no more than this. But even if the process disclosed by Hayduck be held to constitute invention, the patent is invalid for indefiniteness as was held by the learned District Judge. Both the times and manner in which the concentrated nutrient solution is to be added may be ascertained as we have stated solely by experimentation. The disclosure of the patent is therefore too vague and indefinite to constitute invention."

With this conclusion we agree.

As to patent 106 counsel have stipulated—

"The process of this patent is one combining the process of patent '103, including neutralization, and the process of patent '105, including regulated nutrient feed."

Since patent No. 103 is invalid for lack of invention and No. 105 invalid because the disclosure is too vague and indefinite, a claim for patent based upon the mere union of the two processes described therein cannot be sustained where as here, the proposed combination requires nothing beyond the skill of the art.

The challenged decree must be affirmed.

Mr. Justice BUTLER and Mr. Justice STONE took no part in the consideration and decision of this cause.

A true copy.

Test:

Clerk, Supreme Court, U. S.